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INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

Devoted to the Instrument Problems of all Industries

Vol. 2. No. 7 Pittsburgh, Pa. July, 1929

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DR. L. LITINSKY, LEIPZIG, GERMANY

Compression Instrument for Measuring the Strengths of Foundry Sands.
PROF. H. L. CAMPBELL, ANN ARBOR, MICH.

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Improved Method of Installing CO_2 Meter
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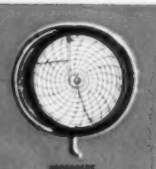

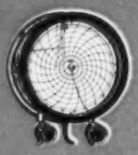

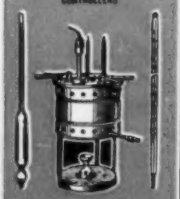

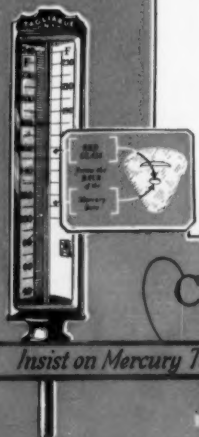

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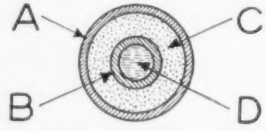

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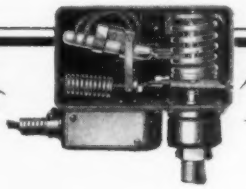

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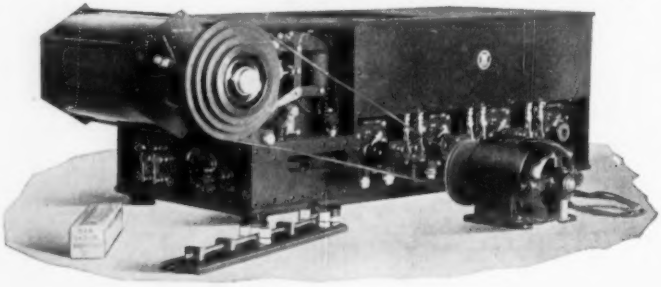

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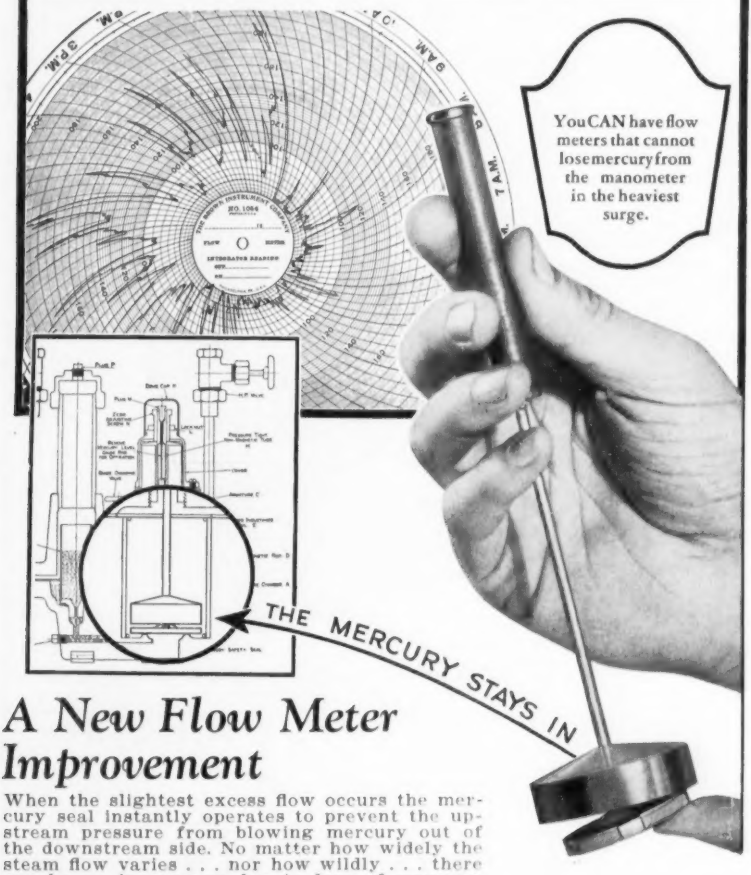

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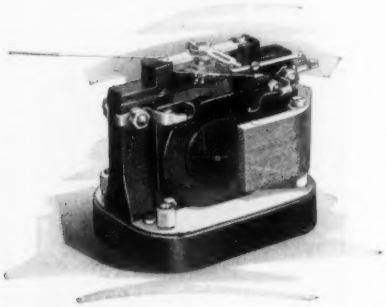

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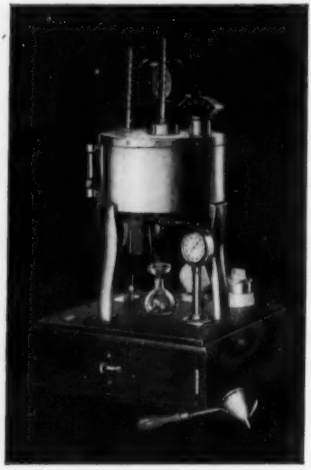

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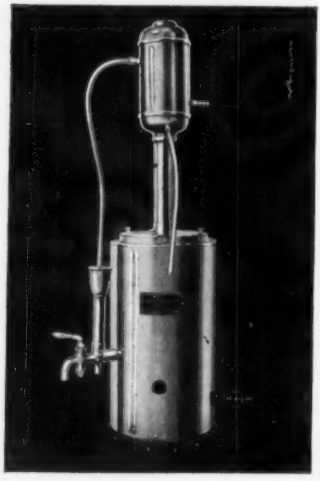

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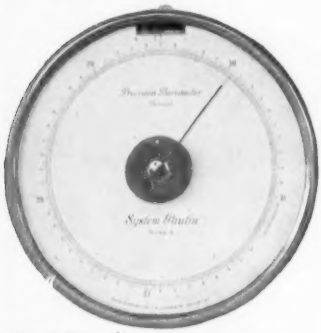

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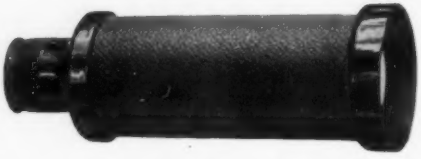

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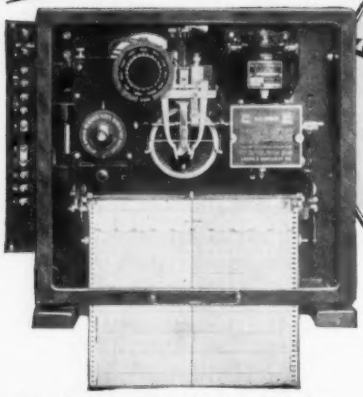

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P-115

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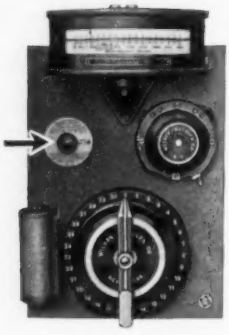

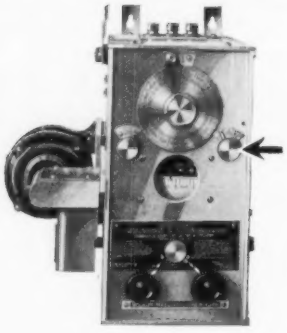

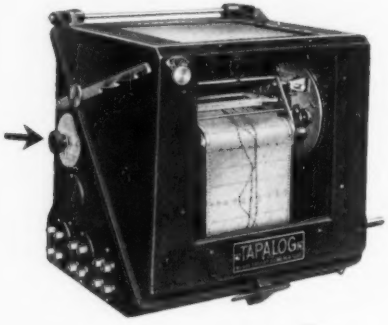

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INSTRUMENTS
INDUSTRIAL — SCIENTIFIC

Vol. 2 No. 7 JULY, 1929 Pittsburgh, Pa.

To Our Readers

EIGHTEEN months ago the first issue of INSTRUMENTS appeared. The appearance of this publication provided a central source of information for all instrument users. As we stated in the first issue, we felt that in presenting INSTRUMENTS we were rendering a distinctly valuable service by disseminating information on the uses of instruments in science and industry.

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H. L. Hazeltine, Chief Engineer, Sterling Varnish Company, Pittsburgh, Pa.
John L. Hodgson, Technical Expert, George Kent, Ltd., Eggington, England.
Prof. George Hosmer, Professor of Geodesy, Massachusetts Institute of Technology, Cambridge, Mass.
Prof. J. W. Howard, Associate Professor of Topographical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.
Prof. Hans von Jueptner, University of Vienna, Vienna, Austria.
Dr. Friedrich Koerber, Director of the Kaiser-Wilhelm-Institut fuer Eisenforschung, Dusseldorf, Germany.
Dr. V. M. Krivibok, Asst. Director, Metallurgical Research Bureau, Carnegie Institute of Technology, Pittsburgh, Pa.
A. A. Lebedeff, Physicist of the Optical Institute, Leningrad, Russia.
John M. Lessells, Engineer in Charge, Mechanics Section, Research Laboratory, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
E. S. Lincoln, Consulting Electrical Engineer, New York, N. Y.
Richard R. Moore, Engineering Department, Wright Aeronautical Corporation, Paterson, N. J.
Dr. Allen Leslie Norbury, Senior Metallurgist, British Cast Iron Research Association, Birmingham, England.
Dr. Albert Parsons Sachs, Consulting Chemical Engineer, New York, N. Y.
Prof. P. H. Schweitzer, Associate Professor of Engineering Research, Pennsylvania State College, State College, Pa.
Dr. Harry Seltz, Asst. Professor of Chemical Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.
Dr. Foster D. Snell, Consulting Chemist, Honorary Secretary of the American Section of Society of Chemical Industry, New York, N. Y.
Thomas Spooner, Asst. Director, Research Laboratory, Westinghouse Electrical and Manufacturing Company, East Pittsburgh, Pa.
Francis M. Turner, Jr., President and Editor, Chemical Catalog Company, New York, N. Y.
Prof. J. W. Tynan, S. J., Assistant Head of the Physics Department and Director of the Seismic Station at Fordham University, New York, N. Y.
Dr. S. R. Williams, Professor of Physics, Fayerweather Laboratory of Physics, Amherst College, Amherst, Mass.
Prof. W. R. Work, Head of the Department of Electrical Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.
C. B. Wright, Supt. Power Distribution, Duquesne Light Company, Pittsburgh, Pa.

The Instrument Exhibits at the Iron and Steel Exposition, Pittsburgh, Pa.

THE Bristol new line of air operated controllers for use on tin pots, pickling tanks and all low temperature control applications, held a prominent place in the Bristol booth. Recording Electric Instruments of round and strip chart type, tachometers, a Blast Furnace Stock Level Recorder, electric controllers and electrically operated control valves completed the exhibit. The feature of the Bristol Company display was the Hot Blast Temperature Control Unit complete with mechanism for operating the mixing valve at a Blast Furnace. A quick reading, ribbon thermo-couple with a light portable pyrometer of the direct reading type was on exhibit for use in securing surface temperatures of hot rolls in steel mills, rubber plants, etc.

The Brown Instrument Company showed a number of flush type instruments mounted on black metal panels: Twelve Record Multiple Recording Pyrometer, Indicating Pyrometer and Switch, Recording Control Pyrometer, Indicating Control Pyrometer, Liquid Level Recorder, Indicating Flow Meter, Recording and Integrating Flow Meter. Forged Steel Monometers in various stages of construction, Portable Pyrometers and potentiometers, Thermocouples, Protecting Tubes, and Automatic Control Valves were included in the exhibit.

The Foxboro Company exhibit consisted of the following: The New Steam Flow Meter in operation; Controlling Pressure and Flow Meters; Integrating and Recording Steam Flow Meters; Pickle Tank Temperature Control and Hand Tachometers.

The General Electric Company voice-controlled toy train was on display.

The complete line of instruments of the Hays Corporation were exhibited by Jno. D. Hiles Company: draft gages, CO_2 recorders, test sets, draft recorders. This company also showed S-C Swartwout feed water regulators.

A Ranarex CO_2 recorder with a special mechanism to show actual working conditions and also a device to oscillate the whole instrument to show its durability and ruggedness was shown by the Permutit Company. The same type instrument is adapted for ammonia recording, for measuring the correct ratio of an ammonia air mixture in nitric acid manufacture. It is also adapted to the measurement of gas densities. This company also showed a small working model of a pressure filter and zeolite softener.

The Pyrometer Instrument Company demonstrated their line of pyrometers: Portable Optical Pyrometer, Portable Radiation Pyrometer and Immersion Pyrometer.

The Republic Flow Meters Company had on display a complete line of instruments manufactured by them. There was shown in cross-section their new type flow meter body, built entirely of steel tubing. The construction of the "U" tube in this meter was of seamless tubing with contact chambers accurately machined. Their control pyrometer was in actual operation on a Hevi Duty Electric Furnace, and the control feature of the pyrometer was so arranged that a mercoid switch handled the entire power in heating the furnace. Another control pyrometer with its thermocouple located in the same furnace was used to operate a motor driven air and fuel valve for controlling temperature in a fuel fired furnace. Other instruments on display were dial type draft recorders, calibrated for reading low drafts at vacuum or pressure, the same type instrument with circular chart recorders, motor driven CO_2 recorders, in which samples of the gas are drawn by means of a motor driven gear pump and the analysis made chemically.

The Roller-Smith Company showed a complete line of a.c. and d.c. portable and switchboard type ammeters, milli-meters, voltmeters, millivoltmeters, volt-ammeters, wattmeters, power factor meters, frequency meters, ohmmeters, circuit testers and shunts. They also exhibited the new type GA graphic recording instruments, various types of open and enclosed air break circuit breakers, various types of d.c. relays and the new type O oil circuit breaker, 600 amperes, 15000 volts.

Rutherford & Uptegraff displayed the following instruments of the Weston Electrical Instrument Corporation: Model 44 electric indicating tachometer, Model 539 portable minature current transformer together with Model 528 1 ampere a.c. ammeter, fan shaped d.c. switchboard instruments and the Junior portable group for a.c. testing.

New model portable ammeters, voltmeters and wattmeters were shown by the Westinghouse Electric & Manufacturing Company.

The Radial Planimeter

JOHN L. HODGSON, M. Inst. Mech. E.

IN a previous article* the author discussed the errors which were involved when the radial planimeter was used to average circular "orifice head" charts.

In the present article it is proposed to consider the theory of the radial planimeter, and to present a method which enables this planimeter to be used for averaging "orifice head" charts in which the spacing is slightly distorted from exact proportionality to the "head" by the presence of cranks or similar mechanisms in the flow meter.

Referring to Fig. 1, it will be seen that the radial planimeter consists essentially of a frame having a slotted portion XY adapted to slide on a peg O fixed at the centre of the diagram. Attached to this frame is a planimeter wheel W having its axis along the line AB. This frame also carries a tracing point P and a rubbing support T to keep the tracing point off the paper.

A small portion of a fluctuating pen line is shown dotted between P and P′ on the diagram.

A very little consideration will show that this so-called planimeter is not an area measuring device at all. It is really a special form of cyclometer. It measures the mean height of a diagram by presenting us with a reading which is proportional to the difference between the mean circumference of the pen line drawn on the diagram and the circumference of the diagram zero circle, which difference is of course proportional to the difference between the mean radii of these circles; i.e. to the mean height of the diagram.

That this is so is easily seen to be the case if it is assumed that the axis AB of the planimeter wheel is made to lie along the line PO, so that the centre of the wheel lies at R′.

If the point R′ of such a planimeter is made to traverse first circle RST, then the line RR′, then circle R′UV, and lastly back to R along the line R′R; the final reading will be proportional to

$$2\pi\,(OR' - OR) = 2\pi\,R'R,$$

i.e. to the difference between the radii of the two circles.....(1)

It is shown in Appendix I that provided the axis AB is parallel to OR this result will still hold at whatever distance the centre of the wheel is placed away from R along a line RS which is at right angles to OR..(2)

It is therefore possible to place the planimeter wheel on one side of the frame RYX, and to provide an easily seen tracing point at P. The fact that P and R are not co-incident does not introduce any error, as if P is taken round the circles to be averaged instead of R, the *difference* between the radii measured is obviously just the same.

*Instruments, November, 1928, pages 479-482.

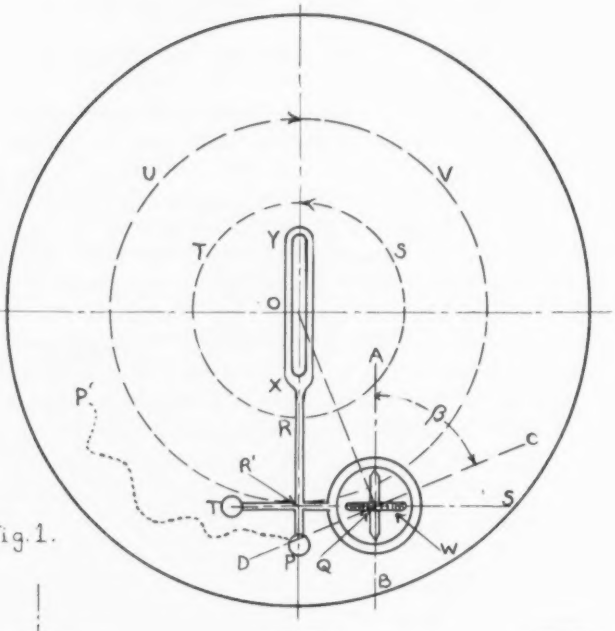

Fig. 1.

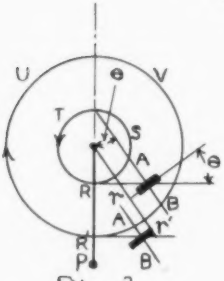

Fig. 2.

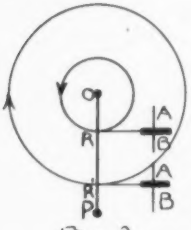

Fig. 3.

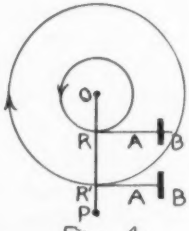

Fig. 4.

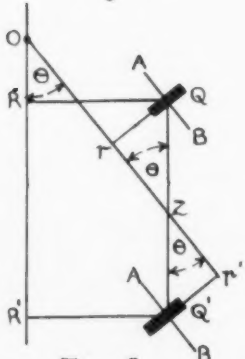

Fig. 5.

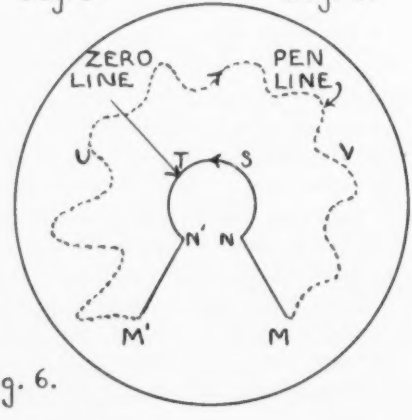

Fig. 6.

It is further shown in Appendix 2 that if the axis AB is fixed at an inclination of θ to the line OR instead of being parallel to it (See Fig. 2), the reading of the planimeter wheel after the traverse above referred to will be proportional to

$$2\pi \text{ R'R } \cos \theta \quad \text{.....(3)}$$

As cos θ can be given any value between unity (when $\theta = 0$) and zero (when $\theta = 90$), a device for setting the angle θ to some stated value for any particular diagram enables an even number to be chosen for the value of the *conversion factor* by which the planimeter wheel readings have to be multiplied in order to give the result in the same units as those marked on the chart.

The method of evaluating a circular diagram by means of a radial planimeter is, therefore, first to decide on a value of θ which will give a simple number (such as 2, 5, 15, etc.) for the *conversion factor c* by which the planimeter wheel readings for the complete traverse RSTRR' UVR'R have to be divided when obtaining the mean ordinates of the diagram. This is best done by making the circles RST and R'UV correspond respectively to the zero and to the maximum ordinates of the diagram, taking experimental traverses, and adjusting θ so that a suitable whole number is obtained for the required factor.

If a number of identical diagrams have to be planimetered, the same reading will be obtained on the planimeter wheel for the same setting θ after going round the circle RST when planimetering each diagram. It is, therefore waste of time to carry the tracing point round this circle, as the reading of the planimeter wheel for a given setting, θ, for one traverse round this circle can be determined once and for all. The planimeter wheel should, therefore, be set at this reading at the commencement of the traverse, or the difference between this reading and 10,000 (supposing this to be the maximum reading of the planimeter wheel dials) should be subtracted from the *difference* of the readings obtained by taking the traverse RSTRR'UVR'R.....(4)

If only a portion of the pen line is to be averaged the traverse NSTN'M'UVMN (Fig. 6) should be taken.

It will be obvious from the above that only diagrams for which the radial distance is exactly proportional to the "head" (or other physical quantity indicated by the diagram) can be accurately averaged by means of a radial planimeter. If the spacing of the "head" lines is not exactly proportional to the increase in radius, an error will be introduced. Where the deviation from exact proportional spacing is small, the error may be allowed for by multiplying the planimeter wheel reading by a *diagram spacing factor, s,* which is tabulated or plotted for each mean height of the diagram.....(5)

The values of this factor can be obtained from measurements of the radii of the circles on the diagram by means of the relation:

$$S = \frac{D/H}{d/h} \quad \text{.....(6)}$$

where d = the distance between the zero circle and the circle corresponding to any head h,

and D = the distance between the zero circle and the circle corresponding to the maximum head H.

Typical values of the *diagram spacing factor s* for a meter in which a crank is used in the transmission of the float movement to the pen arms are given in Table I.

TABLE I

Decimal of max. head	Value of "s"
1.0	1.000
.9	.998
.8	.995
.7	.991
.6	.985
.5	.979
.4	.972
.3	.965
.2	.964
.1	.964

In order to obtain the flow from a "head" diagram, the square root of the mean head obtained by means of a radial planimeter is multiplied by the appropriate constants in the flow formula. Actually it is the mean of the square roots of the heads which should be used in the flow formula. This figure can be obtained by using the square root planimeter described in the article in the March, 1929 issue. It will be remembered, however, that in the article published in the November, 1928 issue it was shown that, provided the maximum ordinate planimetered does not exceed twice the minimum ordinate, only small errors are introduced by using a radial planimeter to obtain flow from a "head" diagram.

These errors are approximately corrected for by means of an "ordinate factor," y, the values of which are given in Table II.

TABLE II

OA/OB*	y
0.5	.925
0.6	.965
0.7	.980
0.8	1.000

It will thus be seen that the mean height obtained by means of a radial planimeter can be expressed by the formula:—

$$h = \frac{r.s.y}{c.t} \qquad \ldots\ldots(7)$$

where h is the *mean height* of the diagram in inches of water or other unit in which the diagram is marked off,

r is the increase in the *planimeter wheel reading* for a traverse corresponding to t *hours*,

s is the *diagram spacing factor* which corrects for the deviation from exact proportional spacing of the lines on the diagram,

c is the *conversion factor* chosen to convert planimeter wheel readings into "head,"

and y is the *ordinate factor* which enables flows to be obtained by averaging a "head" diagram. Its values are given in Table II.

APPENDIX I

TO SHOW THAT IF THE AXIS AB OF THE PLANIMETER WHEEL IS PARALLEL TO OR, (see Fig. 1) THE REVOLUTIONS OF THE PLANIMETER WHEEL FOR ANY GIVEN TRAVERSE OF THE POINT R ARE INDEPENDENT OF THE DISTANCE BETWEEN THE CENTER Q OF THE PLANIMETER WHEEL AND THE POINT R.

The direction of motion of Q will be along CD, which is the line drawn through Q normal to OQ.

Since the linear motion of the edge of the wheel is equal to the distance moved through by Q projected into the plane of the wheel, we have:

$$\text{Revs. of planimeter wheel} = \frac{\text{Distance moved through} \times \sin\beta}{\text{Circumference of wheel}} \qquad \ldots\ldots(7)$$

$$\left.\begin{array}{l}\text{Revs. of planimeter wheel of circumference}\\ \text{for one traverse of the point R' around the}\\ \text{circle R'UV}\end{array}\right\} = \frac{2\pi OQ}{f} \sin\beta$$

$$= \frac{2\pi OR}{f} \qquad \ldots\ldots(8)$$

since $OR' = OQ \sin\beta$

Then for the traverse RSTRR'UVR'R the revolutions of the planimeter wheel will be

$$2\pi \frac{(OR' - OR)}{f} = \frac{2\pi R'R}{f}$$

that is proportional to R'R ..... (9)

It will be seen that (9) is true for all positions of the planimeter wheel W along the line RS.

APPENDIX II

TO SHOW THAT IF THE AXIS AB OF THE PLANIMETER WHEEL IS INCLINED AT AN ANGLE θ TO THE LINE OR (See Fig. 2) THE REVOLUTIONS OF THE PLANIMETER WHEEL AFTER TAKING THE TRAVERSE RBCRR'EFR'R WITH THE POINT R WILL BE PROPORTIONAL TO R'R cos θ.

We have seen in Appendix I that the registration of the planimeter wheel for one traverse of the point R around the circle RBC is proportional to OR, so that if R is extended to R' (see Fig. 3), and a contrary traverse taken, the reading is proportional to (OR' — OR), i.e. to R'R (since the movements along the paths RR' and R'R cancel out.)

*OA/OB is the ratio of minimum to maximum ordinate for the diagram planimetered. See also Figs. 3a and 3b, p. 480 of Instruments, Nov. 1928.

If now the axis of the wheel AB is set at right angles to, instead of parallel to, OR (see Fig. 4), and a traverse is taken as above, there will be no registration at all on the planimeter wheel, as the points R and R′ are co-incident at infinity.

For any intermediate angle θ of inclination of the lines AB and OR (see Fig. 2) the registration for a traverse taken as above will be proportional to rr′, since rr′ is now the length intercepted between the planes of the planimeter wheels on the line through O which is perpendicular to them.

But it is shown in Appendix III that r′r is equal to R′R cos θ. We therefore see that the registration of the planimeter wheel can be made proportional to RR′ cos θ; where cos θ has any value between unity (when $\theta = 0$) and zero (when $\theta = 90$).....(10)

APPENDIX III

TO SHOW THAT r′r (Figs. 2 and 5) IS EQUAL TO R′R cos θ.

Let O in Fig. 5 be the centre of the diagram, Q and Q′ the two positions of the planimeter wheel centre, where QQ′ is parallel to RR′, r and r′ the intersections of the line drawn through the planimeter wheels on the line drawn through O at right-angles to them.

Then we see from the figure that:

$$\begin{aligned} r'r &= r'z + zr \\ &= Q'Z \cos\theta + QZ \cos\theta \\ &= (Q'Z + QZ) \cos\theta \\ &= Q'Q \cos\theta \\ &= R'R \cos\theta \end{aligned} \qquad \text{.....(11)}$$

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Arthur W. Gray, Ph.D., has joined the staff of The Brown Instrument Company as Associate Director of Research. He will be engaged mainly in the development of scientific and industrial instruments. For this work Dr. Gray is well fitted by his long training and experience. He established the Thermal Expansion Laboratory of the Bureau of Standards and originated important methods and apparatus that are still in use there.

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William S. Hallowell, for nearly half a century an officer of the Cochrane Corporation and its predecessor, the Harrison Safety Boiler Works, died at his home in Germantown, Philadelphia, on June 2. He was actively associated in the introduction of the Harrison safety boiler and the Cochrane open heater, and at the time of his retirement a few years ago, was Secretary and Treasurer of the Cochrane Corporation.

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Following their usual practice of having all vacations at the same time, and also to permit of moving into the enlargement of their present plant, the Leeds & Northrup Company will be closed this year from Saturday, August 17th, to Monday, September 2nd, inclusive—except for a skeleton organization to care for emergency requirements.

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The Consolidated Ashcroft Hancock Co., have opened a new enlarged office at 605 West Washington Blvd., Chicago. This office was established with the idea of better serving the customers in the middle West and Far West.

A Slide Rule For Filter Computations

M. K. Kruger*

ELECTRICAL networks such as filters, attenuation equalizers, transformers, balancing networks and speech delay circuits are used in large numbers in many parts of the telephone plant. For example filters separate the voice and carrier frequency currents at the end of each toll circuit on which carrier currents are superposed, and attenuation equalizers are used on broadcasting circuits to give sufficiently uniform transmission over the wide range of frequencies necessary for high grade radio programs. Transformers are extensively used at junction points in circuits where the impendances are unequal, to secure a maximum transfer of energy from the one circuit to the other.

These networks are made up of resistances, inductances and capacities and in some cases the number of elements reaches a hundred or more. In order to ascertain their performance accurately, a large amount of mathematical computation is involved. Any considerations simplifying the work of computation are therefore deserving of serious thought, particularly when a considerable saving in time is thereby effected.

In most cases the solution of electrical networks involving alternating voltages can be simplified by expressing the voltages and currents as vectors, to show their magnitudes and the phase relationships between them. The voltages and currents are represented in polar form, with magnitude and direction given, or in rectangular form, by complex numbers giving the real and imaginary components. Partly offsetting the advantages of this notation, however, is the work frequently involved in solving the equations, particularly the routine operations in transferring them between the polar and rectangular forms.

If a complex quantity is expressed in polar form, its length r and the angle Θ which it makes with the horizontal axis are given, usually in the notation $r \angle \Theta$. In the rectangular form the number is expressed as $a + jb$. The relationship between these notations, shown in Figure 4, is such that either can be changed to the other by the simplest trigonometric equations. Simple as it is, however, the change involves a number of separate computations, and when there is an extensive series of equations to be solved the work of computation is long and wearisome.

Various mechanical devices, some of them specially designed for the purpose, have been used for reducing the time taken by this operation. An ordinary duplex slide rule is used most commonly, but it was designed for general use rather than for this particular operation, and numerous settings of the rule are required. An instance is that the tangent scale between the values 0.1 and 1.0 runs the full length of the

*Apparatus Development Department, Bell Telephone Laboratories, Inc.

slide, while in the same linear distance the sine scale extends between the values 0.01 and 1.0. Since both sine and tangent of the angle are used in each transformation, the time lost in resetting the rule on account of this discrepancy between the two scales is considerable. Other similar situations require more settings of the rule than are inherently necessary for these transformations.

Accordingly in 1916 F. A. Hubbard* designed a special slide rule for vector transformations, with scales provided on it which reduced to three the number of settings of slide and hair line for a complete transformation. Such a rule was later made, and it proved a valuable time saver. It had however two disadvantages. Although its length was twenty inches, the scales were so arranged that the accuracy was only that of a ten-inch rule. Also it was necessary to set up the numerical factors on an inverted scale, reading from right to left; that increased the chance of error from carelessness on the part of users, since the reverse side of the rule was also used for ordinary operations of multiplication and division.

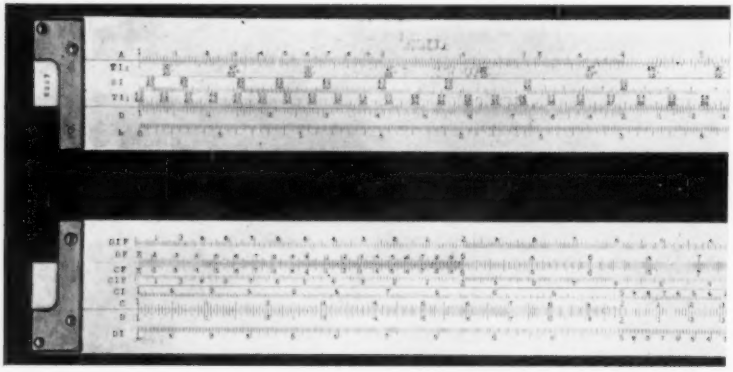


Fig. 1 Above, the front of the new rule, with the added scales, DIF and DI, on the upper and lower stationary sections; below, reverse side, showing the inverted trigonometric scales on the slide.

Another special slide rule, intended particularly for solving equations involving hyperbolic functions, was designed by Professor M. P. Weinbach of the University of Missouri, and was described in the Journal of the A.I.E.E. for May, 1928. Problems involving ordinary complex numbers may be solved as well, but four settings are required for a change from rectangular to polar form, and six settings are needed for the reverse transformation.

To expedite our filter computations, a twenty-inch rule was designed with the scales arranged especially for vector transformations. Preliminary arrangements for its manufacture were made with the Keuffel and Esser Company early in 1928, and in the summer six of the rules were made for the Research Department and the Apparatus Development

*Now Vice-President and Gen. Mgr. of the Mexican Tel. & Tel. Co.

Department. In this rule only one setting of the slide and two settings of the hair line are needed in changing a complex number from either form to the other. The numbers are set on an ordinary logarithmic or D scale, and the operations are performed in the same manner as are multiplication or division on an ordinary slide rule. The results are obtained on the D scale—the full-length logarithmic scale on the stationary part of the rule—and since the rule is of duplex type, additional operations such as multiplication or division may when desired be carried on without a resetting of the complex number.

The front of the rule, shown in Figure 1, has the scales usual for polyphase duplex rules, and has in addition the reciprocal or inverted scales DIF and DI on the stationary part of the rule. These scales, giving the reciprocal of a result directly, end the need for a separate operation to secure a reciprocal. They are specially useful in such operations as finding capacitive reactance and admittance. For obtaining the reactances in a network containing both inductance and capacity only a single setting of the slide is made, and then all the reactances are obtained by moving the hair line.

It is on the reverse side of the slide that the principal changes have been made. Trigonometric scales for sine and tangent have both been inverted, and are both referred to the DI scale—the inverted D scale—rather than to the A and D scales, respectively, as before. Referring both to the same scale does away with the need for resetting the rule to use one function when the other has just been ascertained. The principal tangent scale TI1 runs from 5°43′, the angle whose tangent is 0.1, to 45°, just as in all polyphase rules, and in addition an auxiliary tangent scale TI2 running from approximately 34′ to 5°43′ is given, to cover the angles whose tangent is between 0.01 and 0.1. The sine scale extends between the limits 0.1 and 1.0 only—that is, between angles 5°45′ and

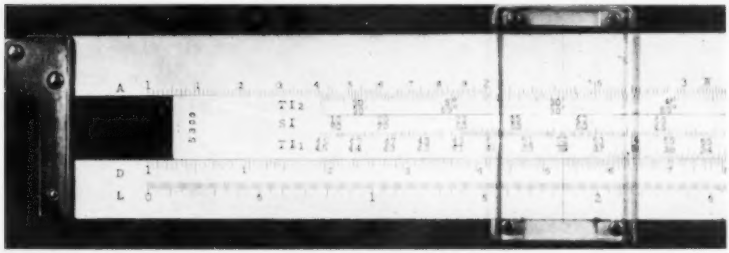



Fig. 2 Beginning of a conversion from rectangular to polar coordinates. When the slide is set on 1195 and the hair line on 1530 on scale D, angle Θ is given as 52° on scale TI_1. The later example is also illustrated here. With the slide set on 119.5 and the hair line on 1530, the angle is read on scale TI_2—5°32′.

90°. For angles less than 5°45′ however sine and tangent are so close together that scale TI2 may be used in place of an auxiliary sine scale without serious error.

Convenience of this rule in changing a complex number from rectangular to polar form can best be shown by a numerical example, such

as 1195 + j1530. First the angle θ is obtained through its tangent. The index of the slide is set on the smaller number, 1195, on the D scale, and the hair line is moved to the larger number, 1530, on the same scale. Then the point on the slide beneath the hair line marks the ratio of the two sides, which is the tangent or cotangent of the angle, depending on which side was larger; in this case the ratio is the tangent. Then the point on the tangent scale beneath the hair line is read directly as the angle wanted—in this case, 52°. With the angle known, the length of the vector is next obtained by dividing the length of the vertical component by the sine of the angle, or the horizontal component by the cosine of the angle. In this case the horizontal side, 1195, is already set on the rule; accordingly the hair line is moved to 52° on the divisions of the sine scale SI corresponding to cosine values, and the length of the vector, 1942, is then found under the hair line on scale D.

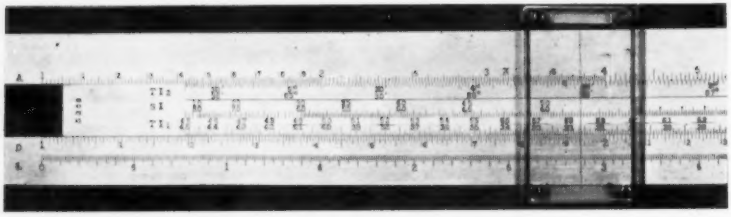


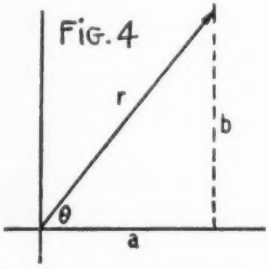
Fig. 3 With θ learned, the slide is left at 1195 and the hair line moved to 52° on scale SI. Then the vector r is given on scale D; its value is 1942.

In the example given, the ratio of the larger to the smaller component was less than 10, and the tangent scale TI_1 was therefore used. When the ratio is between 10 and 100 the procedure is the same except that the other tangent scale on the slide, TI_2, is used. It gives the tangents of angles between 85°43′ and 89°26′, and of course the cotangents of the complementary angles. A case in which this scale would be used is the complex number 119.5 + j1530. The index of the slide is set on stationary scale D at the smaller number, 119.5, just as before and the hair line moved on the same scale to the larger number, 1530. Then the ratio of the two sides appears on the slide, and on scale TI_2 it represents the tangent of angle θ—in this case, 85°32′.

The length of the vector cannot be obtained directly on the rule, since the sine scale has not been continued between 0.01 and 0.1 on a scale comparable to TI_1. Should the vector be wanted closely it can be obtained readily by auxiliary computation, but ordinarily it is sufficiently accurate to take the larger component as the value of the vector. At most the error is one-half of one per cent, when the ratio of the components is just ten, and as the ratio increases the error drops rapidly, so that when the larger side is about twenty-two times the smaller, the error is only a tenth of one per cent. The factor by which the larger component is to be increased is shown in Figure 5; when the desired accuracy justifies the extra computation, the larger component is in-

creased by the fractional percent through additional settings of the rule or by mental calculation. In the example above, the increase is 0.3%, and the length of the vector 1535.

When a complex number in polar form, as 1942 $\angle$ 52°, is to be changed to rectangular form, the operations are the reverse of those already described. The hair line is set on the length of the vector ,1942, on scale D; the angle 52°, on sine scale SI is drawn beneath the hair line; then the hair line is moved to 52°, on tangent scale TI1. Thereupon the two components are read directly on scale D—one of them beneath the index of the slide, and the other at the hair line. That at the index, 1195, is the vector multiplied by the cosine of angle θ and is accordingly the real component; the number at the hair line, 1530, is the imaginary component—the vector multiplied by the cosine of the angle and then multiplied by the tangent.



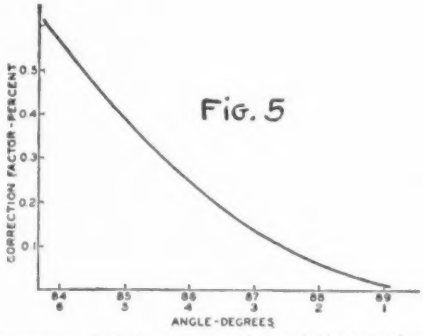


Fig. 4 In a complex number, r is the vector and θ the angle it makes with the axis of real numbers; a is the real component and jb the imaginary component. With either a and b or r and θ known, conversion between polar and rectangular form consists in finding the other pair of values.

Fig. 5 For values of θ not given on scale SI, the larger component is increased in accordance with this curve to get the vector.

Although the rule was originally intended primarily for filter computations, its usefulness is not restricted to those engaged in designing filters. In ten-inch size it would be in many ways advantageous for general engineering and student use. For such a field however certain modifications would be desirable. On the tangent and sine scales the angles should be divided decimally rather than in minutes and seconds, to facilitate interpolation and to simplify addition and subtraction of angles. The scale of equal divisions, or L scale, might well be placed on the front of the rule, and the space on the reverse side vacated by this change used for exponential, or log-log, scales. With that arrangement there would be no need for a cube or K scale, and little if any need for a square—A—scale. Another change, though one whose general advisability is somewhat open to question, is a further modification of the sine scale. That part of the scale between 0.707 and 1.0, or between 45° and 90°, is never used in transforming complex numbers, and its only value is to give directly the numerical values of sines and cosines

within its range. Since these could easily be found from other parts of the sine scale by additional operations, this part of the SI scale could be replaced by an SI_2 scale extending from 5°45′ down to 4°8′. If that were done, the angle whose vector could be obtained directly on the rule would be increased from that with the tangent 10 to that with the tagent 14, and the greatest error which would be present if the vector were not corrected in accordance with the curve of Figure 5 would be 0.3% rather than 0.5%.

Since complex numbers enter into computations in many other fields than those of telephone filters, a rule so made would speed up computations of many sorts, and at the same time fit the general types of computation for which a slide rule is commonly used.

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ELECTRICAL MEASUREMENTS IN PRACTICE. F. Farmer. 1917. Cloth, 360 pages, $4.50.
ELECTRICAL METERS. C. Jansky. 1917. Cloth, 416 pages, $4.00.
PROPERTIES AND TESTING OF MAGNETIC MATERIALS. Thomas Spooner. 1927. Cloth, 385 pages, $5.00.
MAGNETS. Charles Underhill. 1924. Cloth, 449 pages, $4.00.
ELECTRICAL MEASUREMENT. F. Laws. 1917. Cloth, 719 pages, $5.50.
ELECTRICAL MEASUREMENTS IN THEORY AND APPLICATION. A. Smith. 1924. Cloth, 338 pages, $3.00.
METHODS OF MEASURING ELECTRICAL RESISTANCE. E. Northrup. 1912. Cloth, 380 pages, $4.50.
CONNECTING AND TESTING DIRECT-CURRENT MACHINES. F. A. Annet and A. Roe. 1925. Cloth, 237 pages, $2.50.
CIRCUIT TROUBLES AND TESTING. T. Croft. 1924. Cloth, 224 pages, $2.50.
PRACTICAL USES OF THE WAVE METER IN WIRELESS TELEGRAPHY. J. Mauborgne. 1913. Cloth, 74 pages, $1.25.
ELECTRIC AND MAGNETIC MEASUREMENTS AND MEASURING INSTRUMENTS. F. W. Roller. 1907. Cloth, 398 pages, $3.50.
EXPERIMENTAL ELECTRICAL ENGINEERING & MANUAL FOR ELECTRICAL TESTING. V. Karapetoff. Vol. I. 1922. Cloth, 795 pages, $6.00. Vol. II. 1927. Cloth, 620 pages, $5.00.
ELECTRICITY METER PRACTICE. Solomon. 1923. Cloth, 189 pages, $3.50.
THE PRINCIPLES AND PRACTICE OF ELECTRICAL TESTING. R. G. Allen. 1919. Cloth, 365 pages, $6.50.
THE INSPECTION AND TESTING OF MATERIALS, APPARATUS AND LINES. F. L. Henley. 1923. Cloth, 355 pages, $7.00.
TESTING OF MOTIVE POWER ENGINES. R. Royds. 1920. Cloth, 392 pages, $7.50.
DIE TECHNIK ELEKTRISCHER MESSGERAETE. G. Keinath. 1928. Vol. I: Measuring Instruments & Accessories. Cloth, 620 pages, $10.00. Vol. II. Measuring Methods. Cloth, 424 pages, $7.00.
EMPFINDLICHE GALVANOMETER FUER GLEICH UND WECHSELSTROM. Otto Werner. 1928. Cloth, 208 pages. Price $5.00.

PHYSICAL TESTING

MATERIALS TESTING-THEORY & PRACTICE. I. Cowdrey & R. Adams. 1925. Cloth, 129 pages, $1.50.
LABORATORY MANUAL OF TESTING MATERIALS. W. Hatt and H. Scofield. 1926. Cloth, 166 pages, $2.00.
MATERIALPRUEFING UND BAUSTOFFKUNDE FUER DEN MASCHINENBAU. W. Miller. 1924. Cloth, 370 pages, $4.00.

FLOW MEASUREMENT

MEASUREMENT OF AIR FLOW. E. Ower. 1928. Cloth, 194 pages, $5.00.
MEASUREMENT, COMPRESSION & TRANSMISSION OF NATURAL GAS. L. C. Lichty. 1924. Cloth, 523 pages, $7.50.
THE MEASUREMENT OF FLUID VELOCITY AND PRESSURE. J. R. Pannell. 1924. Cloth 148 pages, $4.00.
DIE GRUNDLAGEN DER DAMPFMESSUNG NACH DEM DIFFERENZDRUCKPRINZIP. W. Germer. 1927. Paper, 60 pages, $1.00.

The Determination of Coke Yields for the Coke Plant Based on a Distillation Test.

Dr. L. Litinsky, Leipzig, Germany.

THE author is induced to describe the following method, as it is not generally known in coke plant laboratories. The principle originated with Dr. Bauer, but improvements and modifications have been made from time to time.

A tube of heat resistant Jena glass, 530 mm long and 14 mm inside diameter, closed at one end, is carefully cleaned by washing with water, and then with alcohol and ether, and finally dried. Then 20 grams of the dried powdered coal are introduced, followed by two asbestos wool plugs, which take with them any particles of coal which may have adhered to the sides of the tube. (See Fig. 1.) A long iron rod of about 5mm diameter is then used to bore holes through both plugs in two or three places, to permit the passage of the gas during the experiment. Next there is introduced a column of finely divided, well dried fire clay, about 140 mm in length, which, when heated in the course of the test, functions like the hot retort wall. This is likewise held in position by an asbestos plug, which is pierced as above. The tube thus filled, is weighed and introduced into an ordinary furnace. The balance of the set-up can be seen in Fig. 2.

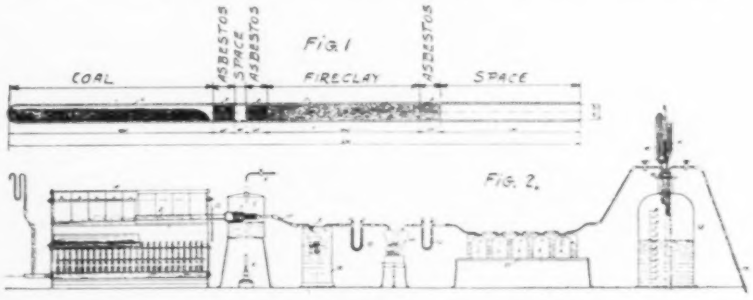

Fig. 1 Distillation Tube, filled before starting the test.
Fig. 2 The Test Apparatus.

1. Combustion Furnace, 2. Combustion Tube with Coal, 3. Fireclay (broken up), 4. Asbestos stopper, 5. Water holder, 6. Continuous Water Supply, 7. Tar Tube with cotton, 8. Burner, 9. Wash Bottle with H_2SO_4 for NH_3 Absorption, 10. $Ca\ Cl_2$ Tube, 11. Wash Bottle with KOH for CO_2—H_2S Absorption, 12. $Ca\ Cl_2$ Tube, 13. Gas Collecting Flask, 14. Rubber Stopper, 15. Mercury Manometer, 16. Thermometer, 17. Vacuum line, 18. Water Container, 20. Napthalene Tube, 21. Benzol Flask in Ice Bath, 22. Manometer to indicate Gas Pressure of Supply Line.

Tube 2 is connected to a tar tube 7 by means of a bored cork. The latter tube is filled with cotton, and is weighed with it before the experiment. Next to this is a smaller tube 20, for naphthalene, with small rubber tube connections and this is followed by the absorption vessel 9, which is filled with N/10 sulphuric acid, to which a little methyl orange

was added, and which serves to absorb the ammonia. Vessel 11 is filled with caustic potash 1:3 for the absorption of hydrogen sulphide and carbon dioxide. Each absorption vessel is followed by a U-tube of calcium chloride (10 and 12). Parts 11 and 12, as well as 9 and 10, are weighed filled before the experiment. Next come five specially constructed small flasks 21 filled with paraffin-oil, weighed separately, and connected together in an ice bath by very tightly fitting, short lengths of rubber tubing. The gas collecting flask 13 is fitted with a rubber stopper 14, which has four holes for the introduction of manometer 15, thermometer 16, and two glass cocks—the gas inlet and the water overflow 17. The balance of the apparatus will be clear from the diagram: 1 the furnace, 5 a water bath, 6 running water, 8 a burner, 18 a pail (not shown) on the floor, 22 an asbestos mat, and 23 a gas pressure gauge.

When all connected up, the apparatus is tested for tightness by setting up a vacuum. Then the cock leading to 17 is closed, the burner 8 under the water bath is lighted, and a constant level maintained in the latter by suitable regulation of the water supply from 6. Then the first right-hand burner of the furnace is lighted. The gas cock 14 is only opened when the heat has established a pressure in the apparatus, so that the gas can collect in 13, displacing the water through the tube 17, which is also initially full of water. Then gradually, at intervals of 6 to 8 minutes, the remaining burners beneath the fire clay are lighted. When this is all red hot, the burners under the coal are lighted, one at a time from right to left, at intervals of about 10 to 15 minutes, according to the rate of gas development. This—or, more accurately, a few minutes earlier—is the beginning of the actual distillation test, which occupies two to three hours. It should be carried through as evenly as possible, and this can be judged from the regularity with which the gas bubbles through the apparatus. The cessation of gas development of course indicates the end of the test.

When this is reached, the temperature of the gas is noted at 13, the degree of vacuum at 15, and a barometer reading is taken. The burners are then extinguished, all cocks in the apparatus closed, and the tube is allowed to cool. When cool, all necessary parts are weighed, as well as the water which has been displaced from 13. For this purpose, such quantity is allowed to be drawn in from the container 18 as will counteract the vacuum. The water in 18 then corresponds to the quantity of gas in 13 at the noted temperature and pressure. It is important, if using a gas furnace, that the test should be carried out under constant conditions, and attention in this respect should be given to the pressure and calorific value of the gas supply.

For working out the results, special formulae can be derived which simplify the calculations considerably. The following example illustrates how this is best done:

1. Coke Yield

Initial weight of tube, including coal, fire-clay, and asbestos	193.0400 gms.
Weight of tube at end of test	188.4700 gms.
First difference	4.5700 gms.

With a file or glass cutter, that part of the tube in which there are tar deposits is now cut off—i.e., the portion between the asbestos shield 22 and the tar tube 7.

Weight of this portion, together with tar deposits	24.8548 gms.
Weight of same, after removal of tar (see ammonia section later) and subsequent heating of the glass to redness	24.6390 gms.
Second difference (C)	0.2158 gms.

The loss in weight due to distillation is, therefore, $4.5700 + 0.2158 = 4.7858$ gms., or $4.7858 \times 100 \div 20 = 23.93\%$, which makes a coke output of $100 - 23.93 = 76.07\%$.

2. Tar

Weight of tar tube 7 after the test, together with tar absorbed by cotton	49.3178 gms.
Initial weight of tube and cotton	48.6754 gms.
(A)	0.6424 gms.
Weight of naphthalene tube 20 after test	5.0620 gms.
Initial weight	5.0608 gms.
(B)	0.0012 gms.

The weight of tar in part of the coal tube (C) was 0.2158 gms., so that the total tar output is

$A + B + C = 0.8594$ gms. or 4.3%.

3. Liquor

Final weight of absorption vessel 9 together with $CaCl_2$ tube 10	88.8554 gms.
Initial weight	87.7626 gms.
	1.0928 gms.

or 5.46%.

4. Ammonia, calculated as Sulphate

After weighing, the contents of the vessel 9, the naphthalene tube 20, the tar separator 7, and (before heating it) the piece broken-off from the coal tube, are carefully washed out with distilled water into a flask, and the liquor is distilled with strong KOH solution; the NH_3 being absorbed by the N/10 sulphuric acid.

N/10 H_2SO_4 total	45.0 c.c.
By titration	6.5 c.c.
Required	38.5 c.c.

from which

$$38.5 \times 0.0017 \times \frac{100^*}{25} \times \frac{100}{20}$$

*$(NH_4)_2$ is four times as heavy as NH_3

or simplified $38.5 \times 0.034 = 1.31\%$ $(NH_4)_2\ SO_4$.

If desired, the combined and volatile ammonia can be determined separately.

5. Benzol

The absorption flasks 21 are weighed, thoroughly dry, before the test, and again afterwards, giving a difference of 0.1260 gms., which represents 0.63% of crude benzol.

6. $H_2S + CO_2 + CN$.

The difference in weight, between the beginning and end of the test, of the absorption vessel 11 with its $CaCl_2$ tube 12 is 0.1822 gms., or 0.91%, representing $H_2S + CO_2 + CN$. The contents of the vessel are washed out, and made up to exactly 200 c.c. with water, and 20 c.c. are fixed with N/10 solution of iodine with starch as indicator.

N/10 iodine used = 2.7 c.c., which give $H_2S = 0.23\%$.

The CN is found by distilling a portion of solution with lead nitrate, the product being absorbed in carbon and nitrated with silver nitrate (Feld's method).

7. Gas Yield

The quantity of gas (free of CO_2 and H_2S) in 13 is given by the weight of water displaced. This is, of course, water saturated, and, for comparison it must be converted into the equivalent at N.T.P. Yield per ton is easily calculated. To find the total gas, including CO_2, H_2S, and CN, the volumes per ton of these can be calculated from the percentages, and added to the gas-make figure, after correction for temperature and barometer reading. Gas analysis, calorific value, and specific gravity are, of course, obtained in the usual manner.

1. The coke make in practice is equal to the mean between the value found as above and that given by the ordinary crucible method. The nature of the residue in the tube gives a very fair indication of the quality of the coke obtainable.

2. The tar make in practice is generally slightly higher than that given by this method, and it is, of course, affected by the temperatures employed in carbonizing.

3. The actual ammonia output is 10% less than the value as found experimentally.

Compression Instrument for Measuring the Strengths of Foundry Sands

*H. L. Campbell**

THIS instrument for measuring the maximum compressive strength of a specimen of sand was first devised by C. M. Saeger, Jr., of the United States Bureau of Standards and later was re-designed by the writer. It has been found to be particularly valuable in foundry sand-control practice.

The specimen which is used in the determination of the strengths of molding sands in compression is the same as that used in the permeability test, which has been standardized by the Committee on Sand Testing of the American Foundrymen's Association. This specimen, which is two inches in diameter and two inches high, is placed on the base of the compression instrument. Directly above the specimen is a movable carriage which is attached to the lower end of a compression spring. At

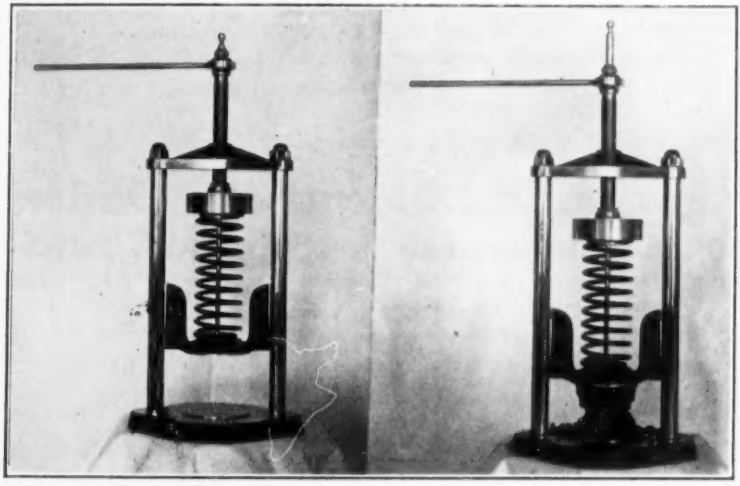

Fig. 1 Fig. 2

the upper end of the spring is a ball thrust bearing. This bearing is connected to a threaded stem which passes through the frame of the instrument. A handle is attached to the stem. By turning the handle clockwise, a load is applied to the specimen, through the spring. As the spring is compressed, a rod which is fastened to the carriage, forces upward a calibrated rod which passes within the threaded stem. When the pres-

*Associate Professor of Metallurgical Engineering, University of Michigan, Ann Arbor, Mich.

sure on the sand specimen becomes great enough to cause it to fail, the spring will recoil, leaving the calibrated rod at its maximum height. This records the maximum compressive strength of the specimen in pounds per square inch.

The speed of rotation of the stem has practically no effect on the results of the test. Less than a minute is required to obtain the maximum compressive strength of a specimen of sand. At the end of the test, the sand is removed from the base of the instrument and the handle is turned counter-clockwise to the former position of the stem.

A packing gland with felt washer is provided at the upper end of the threaded stem. This is adjusted to produce just enough friction to support the weight of the calibrated rod. At the lower end of the calibrated rod is a screw with a flat head. By means of this screw it is possible to fix the zero reading on the calibrated rod. It is possible to adjust the amount of clearance at the two sides of the moving carriage by raising or lowering the brass gibs and then fastening the gibs in position by two screws.

Among the advantages of this instrument are its simplicity and compactness. The load is applied in an axial direction which insures definite information. The spring has been so designed that accurate readings can always be obtained. There is no difficulty with the sand from the specimens getting into any of the moving parts on the instrument.

The compression instrument alone is shown in Fig. 1. At the end of a test and after the specimen has failed, the instrument is shown in Fig. 2.

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MICROSCOPY AND OPTICS

THE MICROSCOPE: Its Design, Construction and Application. F. S. Spiers. 1920. Cloth, 260 pages, $8.00.

THE MICROSCOPE. A SIMPLE HANDBOOK. Conrad Beck. 1923. Cloth, 144 pages, $1.25.

THE MICROSCOPE. AN ADVANCED HANDBOOK. Conrad Beck. 1924. Cloth, 231 pages, $2.50.

THE MICROSCOPIC ANALYSIS OF METALS. F. Osmond and J. Stead. 1924. Cloth, 313 pages, $5.00.

MICROSCOPIC DETERMINATION OF THE ORE MINERALS. W. Davy and C. Farnham. 1920. Cloth, 154 pages, $2.50.

SPECTROSCOPY. E.C.C. Baly. Vol. I, 1924. Cloth, 298 pages, $5.00; Vol. II, 1927. Cloth, 398 pages, $6.00; Vol. III. 1927. Cloth, 532 pages, $7.50.

METALLOGRAPHY. Cecil H. Desch. 1922. Cloth, 452 pages, $5.00.

PHOTOMICROGRAPHS OF IRON AND STEEL. E. L. Reed. 1929. Cloth, 253 pages, $4.00.

IMPURITIES IN METALS. C. Smithells. 1928. Cloth, 157 pages, $5.00.

ELEMENTARY CHEMICAL MICROSCOPY. E. M. Chamot. 1921. Cloth, 479 pages, $4.25.

ELEMENTS OF OPTICAL MINERALOGY. N. H. & A. N. Winchell. Part I. Principles and Methods. 1922. Cloth, 216 pages, $3.50. Part II. Description of Minerals. 1927. Cloth, 424 pages, $5.50.

ELEMENTS OF OPTICS. J. Valasek. 1928. Cloth, 215 pages, $2.00.

THE TELESCOPE. Louis Bell. 1920. Cloth, 285 pages, $3.00.

PHOTOMETRY

LIGHT, PHOTOMETRY AND ILLUMINATING ENGINEERING. W. Barrows, 1925. Cloth, 412 pages, $4.00.

ELECTRICAL PHOTOMETRY AND ILLUMINATION. Hermann Bohle. 1925. Cloth, 427 pages, $11.00.

NEW INSTRUMENTS

Recently Developed by Instrument Manufacturers

Write Information Section, Instruments Publishing Co., Pittsburgh, Pa., for additional information

New Polarization Photometer

(Bausch & Lomb Optical Company)

THE New Bausch & Lomb Photometer uses a Wollaston double image prism, combined with a bi-prism and analyzing prism, but the placing of the essential elements has been so altered from the conventional Martens type that some disadvantages have been overcome. In general, the polarization photometer is one in which the two halves of the comparison field are polarized at right angles to each other. Variation of intensity between the halves is made by rotation of an analyzer prism, the movement of which is read on a divided circle.

The optical system of this new model photometer consists of the elements as shown in the figure. The wide field apperation of 40mm is obtained by two Rhomboid prisms (1-1). The actual entrance pupils (a-a) of the instrument are 6mm in diameter. The collective lenses (2-2)

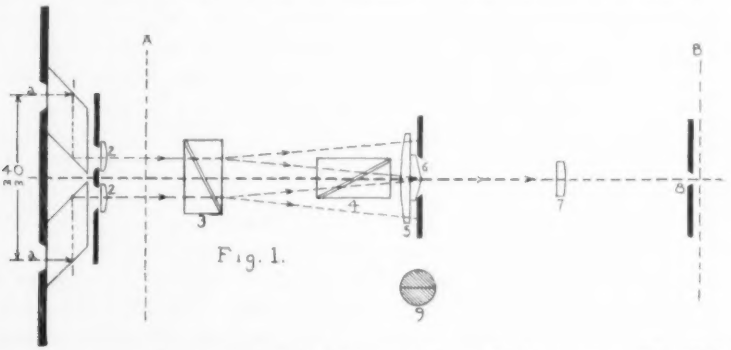

Fig. 1.

serve to secure the proper optical imagery through the system. The Wollaston prism (3) gives, from each aperture, two slightly divergent beams polarized perpendicularly to each other. These beams are analyzed by the Glan-Thompson prism (4), the rotation of which varies the intensity of each beam and permits adjusting the two halves of the field to equality of brightness. The two beams are brought back parallel to each other by the biprisms (6). The objective lens (5) and the adjustable eye lens (7) serve to image the two entrance pupils (2-2) coincidently at the diaphragm (2), which is the eyepoint of the photometer. The field as seen from the eyepoint is shown at (9). The dividing line is the sharp edge of the prism (6). This sketch and brief description of the optical system will serve for the discussion of the advantages and uses of the photometer.

The instrument is designed with two ends in view. (1) When used in conjunction with the standard light source it is an excellent white light photometer and will serve for accurate measurement of light intensity. When used alone in connection with an extended uniform source it offers means for the measurement of photographic densities and work of a like nature. (2) When used with a No. 2700 spectrometer and the No. 2750 Universal Stand, it provides a complete spectrophotometric outfit of a high order of accuracy. It will then give over the visual range readings from which spectral transmission and density curves may be directly plotted.

The photometer, as shown, is essentially of Martens type, but, due to the rearrangement of elements, some disadvantages of this type have been overcome. It will be seen from the description that a single rotation of the analyzer will result in the complete extinction of each field twice or in four so-called extinction points will lie the zero points—position of the analyzer in which the two halves of the field will be matched. In previous designs there has always existed a zero point variation, caused by the action of an inclined refracting surface lying between the polarizer and the analyzer. In the original Martens type the offending unit is the biprism. In that design, two beams, polarized perpendicularly to each other are incident on the opposite inclined faces of the biprism. Due to the difference in effect of the inclined surfaces on the polarized beam, the amount of light transmitted by the two halves of the biprism is not the same and consequently the zero point of the instrument is not exactly 45°. This precludes the use of any type of direct reading which would be correct in the direct and reversed position of the photometer. The new design, however, places the analyzer so that there are no interfering elements between it and the polarizer. The light coming to the biprism in both beams is linearly polarized in the same plane and consequently the action of the biprism on each beam is the same. Hence, a direct reading scale in densities, transmissions or absorptions may be used on the rotating analyzer circle. The circle on the new instrument is graduated to read either directly or indirectly, one quadrant is graduated in densities, a second in transmission (in percent), and the third and fourth in degrees. The diameter of the circle in 6" giving ample space for distinct graduation. It is of German silver, the lines being filled in black.

In order to avoid difficulties due to polarization in the sample, such as strain in glass or liquid polarization, the customary practice has been to change the sample from one aperture to the other or to reverse the photometer. If the sample is reversed there is always the possibility that it has been so distributed that the second value will not be correct. If the photometer is reversed special technical equipment is necessary. These difficulties are avoided in the new design by providing means for reversal within the photometer itself. Referring again to the diagram, there will be seen two vertical dotted lines (A-B). The photometer is so built that the portion lying between the lines (A-B) can be rotated

through an angle of 180° about the optical axis and securely clamped in either position. The mechanical parts are so made that, when assembled, they are accurately centered. This gives assurance that the reversal of the photometer is properly made. The required operation is of the simplest nature and an index at both the left and right sides provides for easy reading in either position. The wide field separation, which proves so useful in certain types of work where the use of large samples is necessary, has been secured by the use of Rhomboid prisms in which the light paths are altered by two total reflections. Since total reflection gives no polarization this feature insures that there will be no disturbing effect due to reflection or refraction before the light beams reach the Wollaston prism, where they are polarized perpendicularly to each other.

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New Universal Spectrophotometric Outfit

(Bausch & Lomb Optical Company)

THE outfit consists of the No. 2700 Spectrometer, the No. 2736 Photometer, and the No. 2751 Universal Stand. The last mentioned unit has been designed so as to be available for all types of spectrophotometric work. In order to make clear the universal nature of the outfit its four possible arrangements are described below.

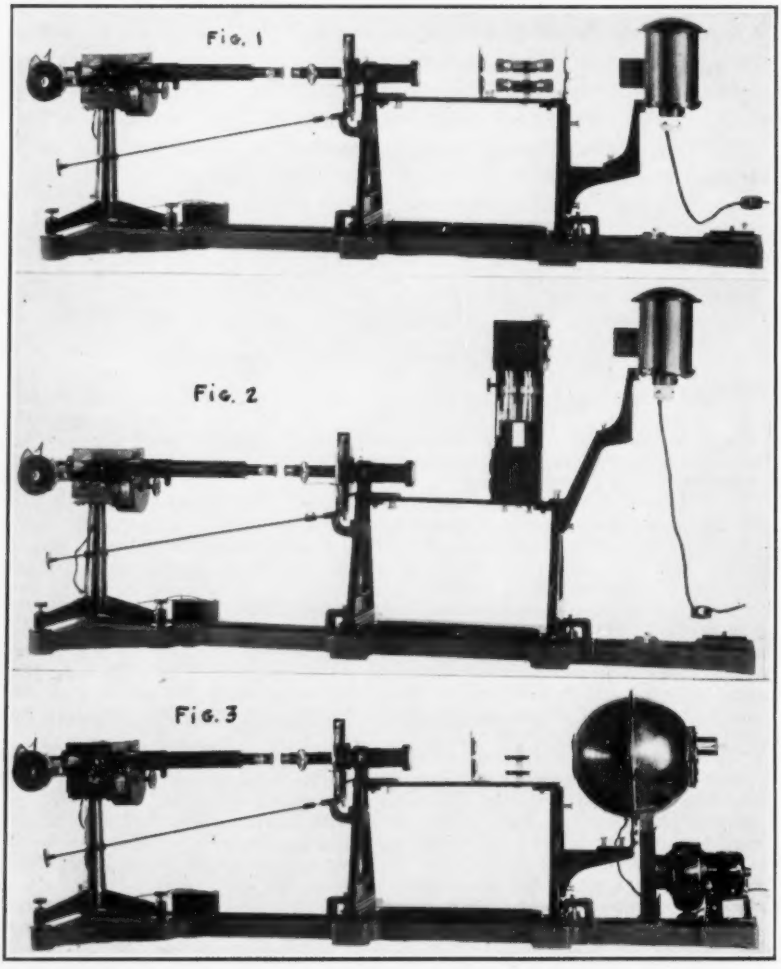
1. The simplest arrangement (figure 1) serves for transmission measurements on transparent solids and upon liquids held in specimen tubes of constant length. The stand carries a ventilated lamphouse in which is mounted a 250W Mazda lamp. The light from this source is passed through a double ground glass window. The photometer is mounted on the opposite end of the stand and between the two are mounted specimen tube holders and a lens and prism system. The specimen tubes are held in saddles, adjustable vertically to bring them into correct alignment in the light paths. The function of the lens system is to furnish, from the single source, two parallel beams of light into which the specimen tubes may be placed and then to focus the beams upon the aperture of the photometer. A 25W Mazda lamp is provided to be used where low intensities are desired in white light photometry.

2. The second form (Fig. 3) of the instrument serves for reflection measurements on opaque samples and for transmission measurements on fixed tube lengths and transparent solids. The lamp house which serves for illumination in the first arrangement is held upon a detachable bracket. This part may be removed and replaced by a 11" motor ventilated sphere. The sphere is made of copper with the interior surface white and contains two 400W Mazda lamps. It is provided with a rotary specimen holder so made that the sample under observation may be brought before either aperture of the photometer. The comparison source is a standard white of a high coefficient of reflection. The sphere may also be used for transmission measurement in which case the rotary holder brings the standard white before both apertures of the photometer. A double lens system gives parallel beams through the specimen tubes or samples which are held as in the first arrangement in front of the exit aperture of the sphere. The ventilating system is arranged so that cool air from the room is drawn over the sample when reflection measurements are being made to protect it, as far as possible against deterioration of color due to heat.

Shields are provided within the sphere to protect the sample from the direct light of the lamps. These shields should be used when the sample being measured is of type which shows a definitely oriented structure, as for instance, a cloth sample in which the thread is evident. If the sample is perfectly uniform

in all directions, the shield may be removed with a resultant gain in illumination. Before using the spheres with the shields removed, the observer should determine very carefully whether the removal will alter the readings on the type of sample being studied. When the sphere is used for transmission measurements the shields may be removed.

3. Recent developments in the technology of dyes and biological stains make it imperative that the transmission of the sample be obtained at varying thickness. The third arrangement (Fig. 2) enables the operator to make transmission



measurements on transparent liquids and solids and to have the liquid columns adjustable to any desired depth up to 65mm. This involves the construction of an adjustable specimen holder which can be easily and accurately controlled. The No. 2756 Vertical Attachment provided for the stand makes it a simple operation to control the depth of stratum from the fraction of a millimeter to about 65mm. The Vertical casting is attached to the bed of the stand. Upon this casting are mounted right angle prisms to alter the direction of the light beams so that they will pass vertically downward through cups and plungers of the colorimeter type. The plungers are of hollow design and are fixed in position. The cups are

of the flare top types and are movable together by rack and pinion. The movement is read on a scale and vernier reading to tenths of a millemeter. Suitable lens systems serve to give parallel light through the cups and plungers.

4. The last arrangement enables the operator to make readings on opaque or transparent specimens of solids and liquids, and to have the liquid column adjustable as described above. In this arrangement the ordinary lamp house is replaced by the sphere and the vertical attachment is used as in the third arrangement.

In any of the four possible arrangements described the parallel beam is ultimately focused on the photometer aperture giving an intense illumination in the field of the photometer. For spectrophotometric determination the eye point diaphragm of the photometer is removed and an auxiliary lens of short focal length substituted. This lens images the photometric field upon the slit of the spectrometer. The spectrometer re-images the field and its dividing line in the focal plane of the telescope objective giving two adjacent spectra. The No. 2710 Shutter eyepiece allows a rectangular section vertical to the dividing line and of any desired width to be selected and compared. The length of the field and the intensity of illumination, are respectively controlled at the entrance slit of the spectrometer by the V slide and the micrometer screw. The two halves of the rectangular field thus formed are brought to equality of brightness by means of the analyzer of the photometer, which is operatable from the observer's position at the eyepoint of the spectrometer. Thus successive portions of the spectrum may be examined and compared and from the data a complete transmission or density curve plotted. Some observers accustomed to the circular type of photometric field find it difficult to use the rectangular field described above. For those who desire it another system is provided which gives the conventional circular field with a horizontal dividing line. The auxiliary lens, used at the photometer eyepoint for the rectangular field, is replaced by a long focus auxiliar lens which images the photometer field in the collimator objective of the spectrometer. The eye lens of the shutter eyepiece is removed and used as the eyepiece of a small observing telescope which goes into the original position of the spectrometer eyepiece and focuses upon the collimator objectives. This system gives a circular homochromatic field the purity of which is controlled by the width of the exit slit in the focal plane of the telescope objective. In general practice, however, it is recognized that the first type of field described, i.e., the juxtaposed spectra type, possesses certain advantages, viz. (1) stray light is comparatively unimportant. (2) Any rapid changes in intensity of either spectrum can at once be seen. On the other hand, the homochromatic field gives complete uniformity of illumination, where, passing through sharply defined absorption bands, while the juxtaposed spectra type of field will show differences of illumination at different points in the dividing line. It has been our experience with this instrument that there is little choice of field type as far as accuracy of reading is concerned.

A cast metal base is provided to furnish a solid and fixed support for the combined instruments. The stand with the ventilating motor, if it is being used, is fixed firmly to the base. Clamps are provided for the motor and the stand. The spectrometer is placed upon the base with the leveling screws in the cone shaped depressions provided. These depressions are in flat members which are movable to secure final adjustments of the spectrometer with reference to the photometer. The moving members are freed by loosening the screws holding the cover plates. When the spectrometer is finally adjusted, the holding screws may be tightened, and the member having the depression in it will be held in fixed position. There is provided as an accessory, a rod and contact wheel by which the photometer circule may be operated from the left side of the spectrometer. A sliding bearing for the rod allows the photometer to be reversed without interference. The scale illumination of the spectrometer and the photometer is secured by means of a single lamp on the spectrometer. A lens and prism in the end of the lamp tube throw direct light upon the photometer scale. Indirect light from the white inner wall of the tube illuminates the wave length scale. The lamp of the illuminator is operated from a 4½ volt battery.

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Improved Method of Installing CO_2 Meters

The Brown Instrument Company has worked out an ingenious method of installing their CO_2 apparatus, working on the thermal conductivity principle. In this system of analyzing gases, the relative capacity of air to conduct heat as compared with the gas to be analyzed, is used to operate electrical indicating and recording instruments calibrated directly in percent CO_2.

The figure illustrates the latest method of installing this apparatus and eliminates many causes for trouble due to clogging, and gas leaks, which are heretofore experienced.

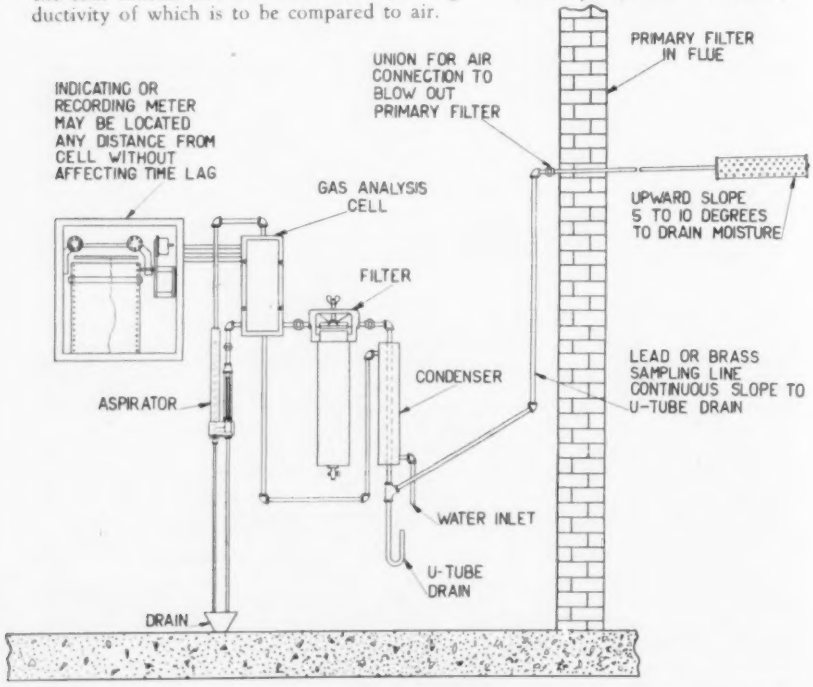
A primary filter consisting of perforated metal supporting asbestos cloth, projects into the flue or furnace. The pipe supporting this primary filter slopes downwards from the filter so moisture is drained off.

The sampling line runs directly down to the U-tube drain which collects excess moisture and acid. The gas then passes through a condenser where it is cooled to prevent any accumulation of moisture in the analysis cell.

A union connection is made at the sampling tubes so the primary filter can be blown out occasionally. In practice, this blowing out is done only at comparatively infrequent intervals.

A secondary filter consisting of a container with steel wool, or cotton, is placed in the line in front of the cell.

The thermal conductivity cell contains four platinum filaments of comparatively heavy wire mounted in gold plated cells with gold lined passages. Two of the cells contain air. The other two contain gas to be analyzed, the thermal conductivity of which is to be compared to air.


PRIMARY FILTER IN FLUE
UNION FOR AIR CONNECTION TO BLOW OUT PRIMARY FILTER
INDICATING OR RECORDING METER MAY BE LOCATED ANY DISTANCE FROM CELL WITHOUT AFFECTING TIME LAG
GAS ANALYSIS CELL
UPWARD SLOPE 5 TO 10 DEGREES TO DRAIN MOISTURE
FILTER
LEAD OR BRASS SAMPLING LINE CONTINUOUS SLOPE TO U-TUBE DRAIN
CONDENSER
ASPIRATOR
WATER INLET
U-TUBE DRAIN
DRAIN

This new piping arrangement, with the improved condenser, filter, and cell assembly, marks a substantial advance in the perfection of CO_2 analyzing apparatus operating on the thermal conductivity principle.

Automatic Instrument for Determining Thickness, Weight and Moisture

(Atlantic Precision Instrument Co.)

THE Verigraph, a recent development in measuring equipment marks the first commercial application of radio in the non-communication field. Instead of speech without wires, the Verigraph provides measurement without touching the material measured. A moving sheet of rubber is weighed simply by passing it between two fixed plates, with no contact at all between the plates and sheet. If it does touch either or both plates, weighing is not affected; but it works just as well with no physical contact whatever. A strip of cold rolled steel is calipered and continuously indicated and recorded to a fraction of a ten-thousandth of an inch, as the stock travels along between the plates. Or in another field—controlling moisture content—the control originates with the hygrometer, placed somewhere within a quarter of an inch of the moving material.

Verigraph designates a group of precision instruments which use well known radio principles and apply them in a novel manner to manufacturing requirements. The use of radio makes this measurement possible without touching the material measured; a factor of vital importance, particularly in the measurement of moving materials of all sorts—since the Verigraph is inherently unaffected by surface conditions, by speed, in fact by all the usual difficulties which come with contact with a moving sheet. Also all moving parts are eliminated (except of course, the moving element of the electrical indicator and recorder). No moving parts to wear, adjust or get out of order. Likewise, important gains in accuracy and flexibility are realized. Specifically, Verigraphs are used for weighing sheet rubber or rubberized fabric, paper and other non-conducting materials, for calipering the thickness of sheet metals of all kinds, and for measuring the moisture content of paper and similar materials. All are closely alike in principles involved, in the fact that in no case is physical contact between measuring instrument and measured material required, and because all are built for factory operation, to give continuous reliable performance without specialized attention or operators.

Verigraphs are all alike in principle, regardless of their use. Each consists of three essentials—a "measuring condenser," an "oscillator," and an indicator and recorder. The "measuring condenser" is an electrical condenser whose capacity is varied by the material being measured—weight, thickness, or moisture. The "oscillator," a miniature radio transmitter and receiver, is extremely sensitive to any change in the capacity of the "measuring condenser" and greatly magnifies the effect of this change. The indicator and recorder indicate and record the

changes of capacity of the "measuring condenser" as magnified by the "oscillator," and hence a continuous indication and record of the material being measured is provided. To the recorder may be attached electrical contacts to provide any of a number of types of automatic or semi-automatic control.

The heart of the Verigraph is the oscillator. It is here that the real measuring takes place; the features of the oscillator lie behind and are responsible for all the unique characteristics of the Verigraph; likewise it is the oscillator which is so utterly different from anything found in any other measuring apparatus. It consists essentially of a complete radio transmitter and receiver in miniature, all housed in a single heavy aluminum case. Just as the ordinary radio receiver is tuned by a dial moving a variable condenser, the receiving circuit of the Verigraph is tuned by the "measuring condenser." As the receiving circuit gets more closely tuned to the transmitting circuit, the "loudness" increases, just as in the ordinary broadcast receiver. It is this "loudness" that is measured by the indicating and recording mechanisms. Of course, being especially designed for this purpose, the system is very sharply tuned, that is, a very minute change in the capacity of the "measuring condenser" produces a very large change in response, and thus a large proportionate indication on the meters.

There are a number of special features of this "oscillator"—details of design permitting it to be run entirely from a single vacuum tube—arrangements so that the whole apparatus operates from the ordinary light socket—provision for eliminating, or compensating for changes in voltage. wave form, temperature, and so on. The whole apparatus is designed for shop operation—dust proof, water resisting, and extremely rugged. There is a dial, used for calibration of the apparatus, and a small ammeter, which shows when the tube approaches the end of its useful life. Tubes are interchangeable, simply a matter of taking one out and putting another in. The oscillator is housed in a cast aluminum case, and nothing short of driving a truck into it will upset its adjustment.

The "measuring condenser" is obvious from the discussion of the oscillator. It is a condenser whose capacity varies with the property of the material which it is desired to measure. The form of course depends on what is to be measured. For weighing rubber and similar materials, a pair of plates are supported in a rigid yoke. Between these plates passes the material to be weighed. (For convenience in starting, cleaning, etc.

*In theory, of course, the capacity of the condenser varies as a function of the thickness of the material and its dielectric constant; specifically

$$C=kdA/Td + t(1-d)$$

where C is the capacity of the condenser
k is a constant, depending on the units used
d is the dielectric constant of the material
A is the area of the plates
t is the thickness of the material
T is the spacing of the plates

Since the dielectric constant of any particular material remains in practice very nearly constant, the capacity may be said to vary as a function of the mass of material between the plates. The Verigraph is a calibrated instrument entirely; variation of dielectric constant between various materials have no effect, being taken care of in calibration.

a compressed air operated lift instantly opens the spacing of the plates to two inches. On release of the air, the plates resume exactly the original, normal position). Any change in the weight of the dielectric material between the plates causes a change in the electrical capacity between plates* and is immediately shown on the indicator and recorder.

For calipering the thickness of metals, two small plates are fixed on opposite sides of the sheet or strip. This makes really two small condensers, whose capacity increases as the material becomes thicker**. This increase in capacity acts through the oscillator, to show on an indicator and recorder as an increase of thickness.

The moisture measuring apparatus consists of a specially sensitized ribbon held in a trough close to the moving sheet. Minute changes in the length of this ribbon in response to changes in moisture, move one plate of a variable condenser. This change of capacity is registered as increase or decrease of moisture on indicator and recorder***.

Standard indicating and recording millivoltmeters are used. The characteristic of these instruments may be varied to give a point by point detailed picture, or they may be "damped" to give an average over almost any desired period. The latter is generally more useful for actual control purposes; however, this can be arranged for particular conditions. The indicator and recorder may be placed as convenient—there is a single pair of wires running from the oscillator to the indicator and recorder. To the recorder may be attached contacts for various types of control mechanisms. Such mechanisms are designed for the particular type of process and machinery to be controlled. In most cases automatic control works out very satisfactorily.

Verigraphs are calibrated instruments; a standard for the material is established, a setting of the dial of the oscillator of the Verigraph is established corresponding to this standard—and variations above or below this standard are shown on indicator and recorder. There is a dial setting for each material, or group of materials; this setting is permanent, and is used whenever the particular material is run.

In operation, it is like the dial of a radio set—except that each dial setting corresponds to a particular material rather than a particular station, though, of course, on the Verigraph the dial settings are much more reliable and accurate than on the usual radio receiver.

The nature of the apparatus provides enormous inherent sensitivity, in most cases far greater than is desirable to use. For instance, the caliper readily gives the full swing across the scale of the indicator for one ten-thousandth of an inch variation. This sensitivity can be reduced as desired, so that normal variations occurring despite best control practice, produce easily read but not excessive deflection of the indicator and

**The two condensers are in parallel, with an air dielectric. An increase in the thickness of the stock reduces the thickness of the air gap, between stock and fixed plates, thereby increasing capacity. Any slight shift of th estock from the center of the fixed plates increases one capacity the same amount that it decreases the other; very accurate centering is therefore unnecessary.

***The sensitized ribbon in the trough near the sheet assumes a moisture content in equilibrium with that of the sheet. The ribbon takes up or gives off moisture till its condition matches the sheet, and thus is independent of temperatures. The Verigraph registers absolute moisture content of the sheet, rather than absolute humidity.

recorder. The fact of great reserve sensitivity contributes to making the apparatus extremely flexible. The fact that the apparatus is not operating at the outside limit of sensitivity contributes to the ruggedness and stability.

The Verigraph has already demonstrated its value in a considerable number of paper and rubber mills. Its use in metal calipering is just being opened up. Other uses are constantly being developed, for weight and caliper of a variety of materials. Likewise, several quite separate and distinct fields show great promise at the present time.

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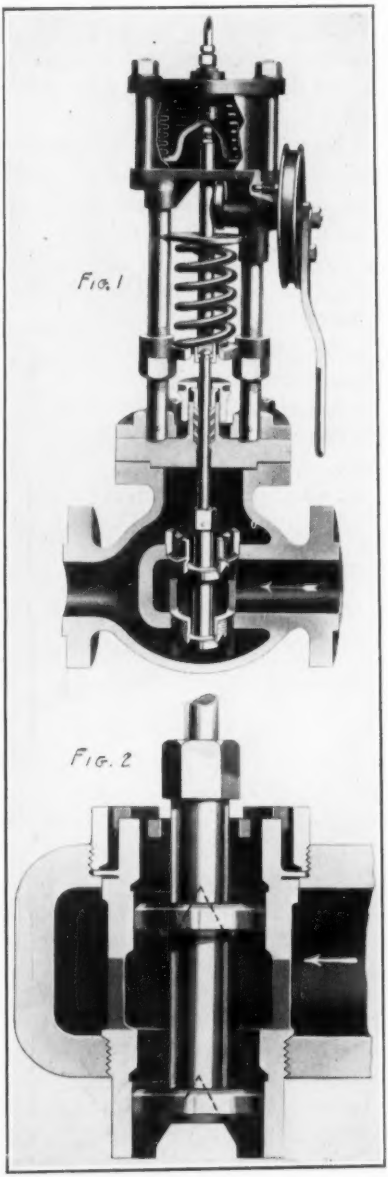
New Thermo Hydraulic Feed Water Regulator

A THERMO hydraulic feed water regulator which embodies new and improved features has been developed by the Bailey Meter Company.

Fig. 1 shows the regulating valve used in this new thermo hydraulic regulator, and from this will be noted that the valve is tight seating, has scientifically designed V-ports and is fully balanced. In operation these features result in freedom from danger of flooding boilers at low rates of steaming or when on bank; smooth continuous feeding of boilers while in normal operation, and a positive, non-chattering action of the regulating valve.

If seats must be reground or replaced the entire valve cage can be removed from the regulating valve without removing the valve body from the line. The old cage, or a new one, can be replaced in the valve body with the assurance that all moving parts will be in perfect alignment, since the entire balanced valve mechanism is contained within the cage as shown in Fig. 2. This method of construction eliminates the necessity of removing the entire valve body and machining the seat after it has been installed.

Another interesting feature in this valve to be noted from Fig. 2 is the recessed rings in the valve cage immediately below the valve seat. The purpose of these recessed rings is to prevent cutting of seats



and valve discs by wiring drawing at the tips of the V-ports. By means of these rings the flow is evenly distributed so that equal wear occurs on all parts of the seat when the valve is operating near the closed position.

A lever and cam is provided on the regulating valve so that in case it ever becomes necessary to regulate feed water by hand the regulating valve can be quickly opened by a half turn of the by-pass lever. For installation where the valve will be located at a considerable distance above the operating floor a sheave wheel is provided on the valve so that it can be by-passed by means of a cable operated from the operating floor.

New features which are incorporated in this thermo hydraulic generator, which is located at the boiler water level, are a cold water storage leg, a condensate by-pass and a vacuum seal. The cold water storage leg, together with a large fin area on the generator tube assures rapid condensation of steam in the annular space between the inner and outer generator tubes, which in turn results in positive closing of the regulating valve as the boiler water level tends to rise. Condensate which forms in the connecting piping between the generator and the boiler drum is returned to the boiler by means of the condensate by-pass. This prevents erratic and false operation of the regulating valve which would be caused if the condensate were allowed to drain back to the boiler through the generator. The vacuum seal causes instantaneous closing of the regulating valve in case the boiler water level ever exceeds the upper limit of variation allowed by the regenerator.

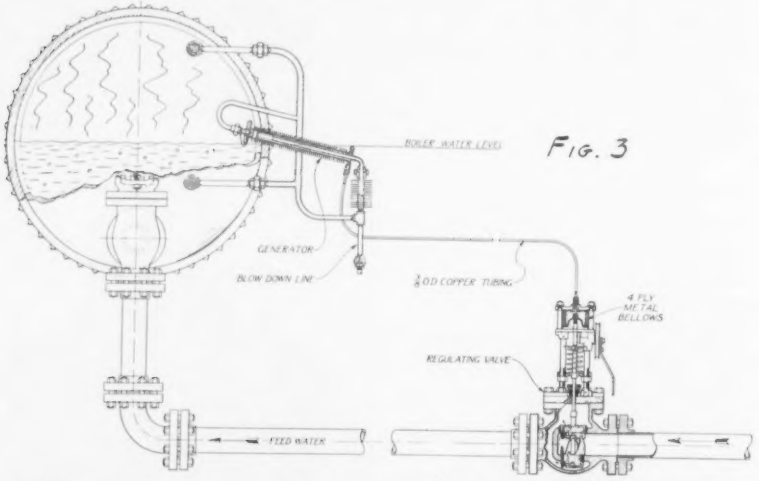


FIG. 3

There are no limitations as to where the regulating valve must be installed in the feed line, since only a hydraulic connection is necessary between the sylphon on the regulating valve and the annular space between the tubes of the generator. This connection is made by ⅜ inch O. D. soft annealed copper tubing as is shown in Fig. 3.

Type FD Pyrometers

(Roller-Smith Company)

THE Roller-Smith FD Pyrometer consists of an exceptionally rugged D'Arsonval type of milli-voltmeter, calibrated to read temperatures from 0 to 1200 degrees F. The scale is graduated to read in 20 degree divisions. The dial is of white bristol board with black inscriptions. The moving element of the instrument is carried on polished steel pivots

ruggedness, which is so essential in an instrument that may be mounted on a machine subject to constant vibration. The instrument case is finished in black rubberoid, baked-on enamel, which working in the highest grade Ceylon sapphire jewels. Wherever possible the moving parts are made of aluminum and in accordance with the best practices of electrical instrument design. Every effort has been made to secure gives a finish exceptionally durable and proof against scratches, corrosive action of gas fumes, etc.

The instrument is compensated automatically for changes in temperature and cold end differences by means of a thermostatically operated magnetic shunt operating on the instrument magnet. This consists of a small block of magnetic metal pivoted on a spring of special thermostatic metal, mounted so that it is free to approach or to recede from the poles of the instrument magnet. As the temperature changes the thermostatic spring expands or contracts, moving the metal block in such fashion as to weaken or strengthen the field of the magnet, in this way varying the strength of the magnetic field in which the moving system of the instrument rotates. There are no "cold end" errors, no allowances to be made, no adjustments to make, as the automatic compensator takes care entirely

of the compensation. The E. M. F. actuating a pyrometer is a quantity which varies with the difference in temperature between the hot and cold junctions of the couple and, if it proves inconvenient to maintain the cold end of the couple at a constant temperature, as it is in this application, the instrument must be compensated accordingly. The extreme simplicity and durability of this form of compensation will at once be apparent and the fact that it is entirely enclosed by the instrument case and, therefore, free from external injury or tampering, renders it exceptionally desirable.

The pyrometer is guaranteed to be accurate to within one scale division, i.e., 20 degrees F. at any point of the scale and at the working point where the highest accuracy is necessary, this usually being the 800 degree point, the accuracy is guaranteed to be within 15 degrees F., plus or minus.

The thermo-couple casing consists of a ½" tube 9" in length. This may be inserted into the type metal pot up to a flange, which is permanently secured 5¼" from the fire end. A section of armored tubing is built into the couple, protecting the instrument leads up to the point where they are attached to the instrument terminals.

The insrument is equipped with a mounting clamp by which it may be fastened against a vertical iron pipe that can be attached to the type casting machine or the clamp can be passed around any convenient pipe or conduit not attached to the machine, which happens to be in close proximity to it. If no pipe or conduit is available the instrument can be mounted on a simple little panel, which any one can readily make up and can be attached to a nearby wall or other support. The thermo-couple can be placed vertically in the type metal pot and, for convenience, most users fasten a little strap of iron to the edge of the pot having a hole in the inner end sufficient to clear the thermo-couple. In this fashion the thermo-couple is kept located at the portion of the type metal receptacle having the greatest depth and constancy of readings is thus assured. The dimensions of the support iron vary with different types of machines.

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New Improved Gravitometer

(Eimer and Amend)

THE latest type gravitometer, shown in three operating positions, has no elevating platform or counterbalancing nuts, and is described as follows: The ample base carries an upright standard in which are pivot cups for supporting the beam. The graduated scale is also supported on the front face of this upright member and is rotatable about the center line passing through the pivot cups. This scale is attached to a friction member in such a manner that it will stay in any position it is placed and yet it is easily rotatable. The base also has a slot in the front portion extending nearly the length of the base. In this slot slides the index finder which carries a fine wire perpendicular to the base and arranged so that the wire is in light contact with the scale. The base is also supplied with a sensitive spirit level and an electric buzzer. It has also an enclosure to receive the water jar.

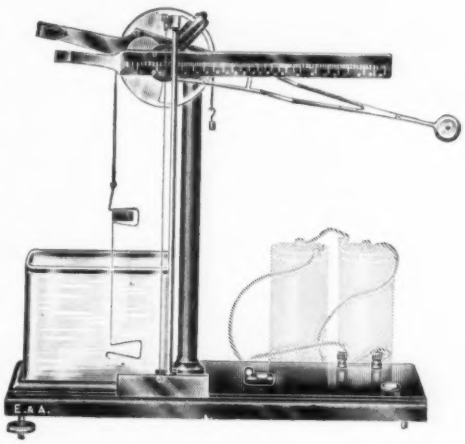

Fig. 1—Weighing Sample in Air

The beam, which is supported in the pivot cup, is constructed of aluminum and consists of a drum about four inches in diameter and with a ¾-inch face. Through the exact center of this drum passes the pivot upon which the whole beam rotates. Securely attached to the front of the drum is the aluminum casting which carries, on one end, a circular mirror which has a small red circular index in its center. The center of this mirror is ten inches from the center line of the pivot. The

Fig. 2—Scale Adjusted to Beam in Equilibrium

opposite end of the aluminum casting carries a pointed index for use in lining up the scale with the beam.

A tape passes over the face of the drum and is securely attached to the drum in a position exactly diametrically opposite the center of the mirror. The left end of this tape is attached to the double suspension hook and the other end to a counter weight. The upper hook is always above the water level and the lower hook is always immersed.

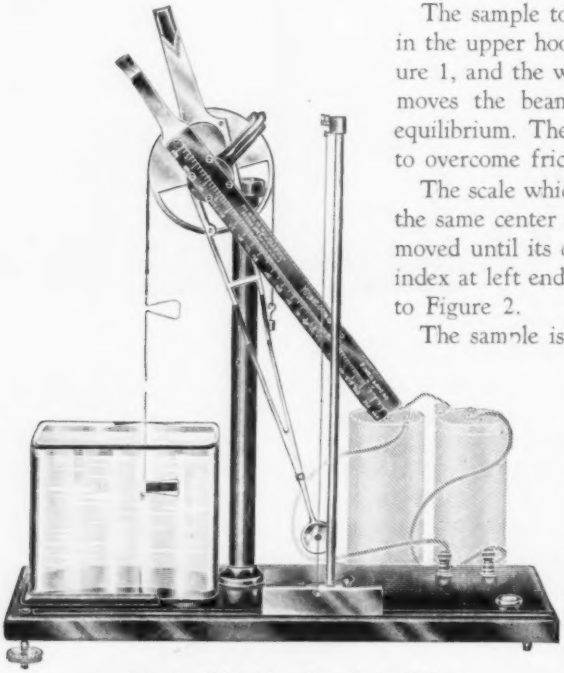

Fig. 3—Weighing Sample in Water

The sample to be tested is placed in the upper hook, as shown in Figure 1, and the weight of the sample moves the beam to a position of equilibrium. The buzzer is operated to overcome friction.

The scale which is rotatable about the same center as the beam is then moved until its center line is on the index at left end of the beam. Refer to Figure 2.

The sample is then placed in the lower hook, as shown in Figure 3, which is immersed in the jar of water and the beam moves in a clockwise direction until in equilibrium. The buzzer is operated to overcome friction. The operator then moves the vertical index finder to the position so that its hair line passes through the red center of the mirror. This may be accurately set by placing the vertical index finder so that the image of the hair line when lined up with the hair line itself passes through the red center. The specific gravity is read directly on the scale at the point where the hair line crosses the center line of the scale.

Gravities may be determined at the rate of more than one per minute, making this new instrument of great service to all rubber factories, notably in laboratories, rubber compounding departments, curing and mixing rooms, and control departments where the checking of gravities is an important part of the daily routine work.

Description of the Latest Forms of the Hilger Polarizing Instrument Known as Professor Coker's Photo-Elastic Apparatus

(*Adam Hilger, Ltd.*)

IN a previous issue of INSTRUMENTS[1] various designs of polarizing instruments for determining the distribution of stress in structural and machine members were described, including the Coker instrument.

Such instruments allow the magnitude of the difference of the principal stresses p and q to be established from tests, also the directions of the principal stresses. From this the principal stresses are obtained separately by a process of graphical integration.[2]

In this note the three latest forms of the Coker apparatus are briefly discussed. The principle of establishing the principal stress directions is the same for any design. There exists, however, a difference in the manner of obtaining the stress-difference p-q.

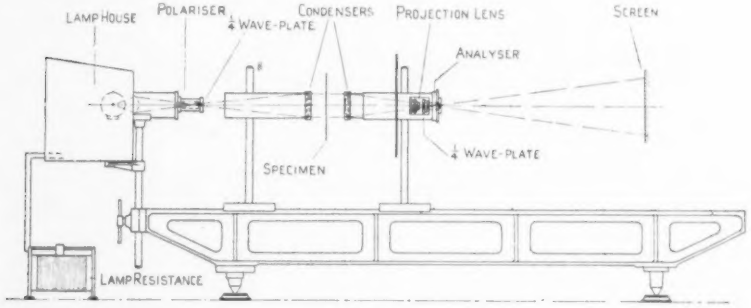

Fig. 1

The Simple Projection Apparatus, Fig. 1: In its simplest form the apparatus consists of the equipment as shown in Figure 1. In order to obtain the magnitude of p-q, the colors of the loaded model can be compared with the colors of a strip of the same material, subjected to tension or bending.[3]

The Projection and Calibration Apparatus, Fig. 2: This instrument is built so as to provide that the polarized light passes not only through the loaded model but also through a compensator.

Two types of compensators exist: namely, (1) strip of same material as model, subjected to a variable, but known stress, later on referred to

[1]Baud, Description of a Polarized Light Apparatus for Photo-Elastic Work, INSTRUMENTS, Vol. 1, No. 9, September 1928, p. 393.

[2]Baud, "Experimental Methods of Studying Stress Distribution," and "Further Development in Photo-Elasticity," Journal of the Optical Society of America and Review of Scientific Instruments, Vol. 15, Number 5, May 1929.

as strip-compensator and, (2) crystal, later on referred to as crystal-compensator.

In order to insert a compensator, the apparatus shown in Fig. 1 requires additional equipment consisting of a condenser and a lens made up as a single unit, and an extra condenser.

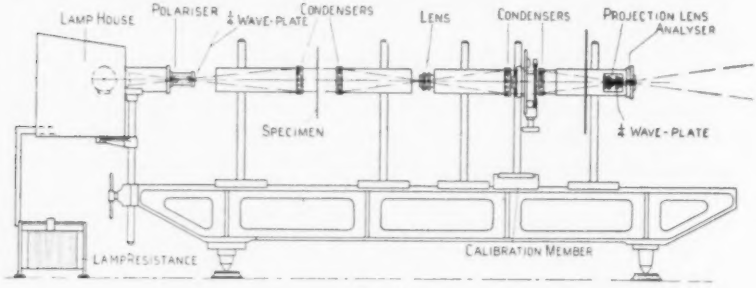

Fig. 2

The projection and calibration apparatus is suitable for commercial photo-elastic work and for this purpose a strip-compensator outfit is all that is required, whereas the Research Model, described below, should also have a crystal-compensator outfit for scientific research.

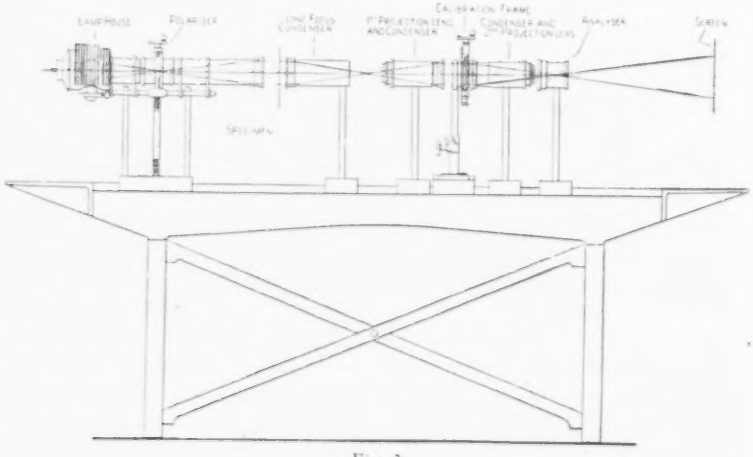

Fig. 3

The Research Model, Fig. 3: This model is practically the same as the apparatus which was described on page 394 in a previous paper.[2] It differs from the projection and calibration apparatus, Fig. 2, only in the optical components, which are of superior quality.

An instrument of this type (Research Model) was acquired in 1923 by the Westinghouse Electric & Mfg. Co. It has been used continuously ever since in the Research Laboratory of this organization at East Pittsburgh in connection with problems such as determining the stresses in gears, threads, suspension insulators, commutator bars, dovetail-joints, turbo rotor teeth, turbine blades, etc.

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ABBE REFRACTOMETER. Bulletin takes up principle and construction of the instrument as well as operation and adjustment. Bausch & Lomb Optical Company, 637 St. Paul St., Rochester, N. Y.

ARTIFICIAL LOADS. Bulletin describes a new line of artificial load boxes. Distinctive features of the Tesco artificial loads are given. Eastern Specialty Company, 3551 North 5th St., Philadelphia, Pa.

BALANCES—QUICK WEIGHING. Leaflet describes new quick weighing quadrant balance. Julian H. Becker, Delft, Holland.

BLOWERS—LOW PRESSURE ROTARY POSITIVE TYPE. Bulletin 22-B-1 covers the new Roots modernized blowers equipped with Timken, SKF and Hyatt Bearings. P. H. & F. M. Roots Co., Connersville, Ind.

CHEMICAL MICROSCOPE. Bulletin gives information on the Chamot Chemical Microscope. Bausch & Lomb Optical Co., 637 St. Paul St., Rochester, N. Y.

CIRCUIT BREAKERS. Bulletin 580, Supplement 1-A gives capacities of Type EAF circuit breakers in tabular form. Roller-Smith Co., 233 Broadway, New York, N. Y.

COLORIMETERS AND HEMOGLOBINOMETERS. Catalogue is devoted exclusively to colorimeters and Hemoglobinometers. The principle of the Duboscq colorimeter is given. Bausch & Lomb Optical Co., 637 St. Paul St., Rochester, N. Y.

DIPPING REFRACTOMETER. Bulletin discusses application construction, accuracy and manipulation of the Bausch & Lomb dipping refractometer. Bausch & Lomb Optical Company, 637 St. Paul St., Rochester, N. Y.

EBULLIOMETER. Bulletin No. 230A describes the Juerst Ebulliometer, specially adapted for determining the percentage of alcohol in temperance drinks. Eimer & Amend, Third Ave. and 18th St., New York, N. Y.

EDUCATIONAL MICROSCOPES AND ACCESSORIES. Bulletin shows microscopes best suited to use in educational institutions. Bausch & Lomb Optical Co., 637 St. Paul St., Rochester, N. Y.

EXPERIMENTER. The April issue of the Experimenter contains the following articles: A New Frequency Standard; An Alternating-Current-Operated Radio-Frequency Oscillator; A Speaker Filter for the 245 Type Tube. The May issue contains: Permalloy; Power Transformers for the 245 Type Tubes; Variable Air Condensers for Use with High Voltages; A Capacity Unbalance Bridge for Cable Testing.

FLOW METERING SIMPLIFIES PLANT OPERATION. Direct Mail Piece considers application of flow meters in various industries. Brown Instrument Co., 4482 Wayne St., Philadelphia, Pa.

FLUORESCENCE MICROSCOPE. Leaflet briefly describes this instrument. Bausch & Lomb Optical Co., 637 St. Paul St., Rochester, N. Y.

FUSING POINT OF COAL ASH APPARATUS. Bulletin No. 402 discusses importance of determining fusing point of ash. Instrument is described and directions for use are given. Eimer & Amend, Third Ave. and 18th St., New York, N. Y.

GRAVITOMETER. Bulletin No. 418 describes Young's Gravitometer for direct reading of specific gravities of rubber and similar materials. Eimer & Amend, Third Ave. and 18th St., New York, N. Y.

GROWING USE OF TIME RECORDERS. Bulletin 529 discusses application of time recorders for several industries. Esterline-Angus Company, Indianapolis, Ind.

HYDROGEN-ION COLORIMETRY. Bulletin takes up B & L Hydrogen Ion Colorimeter. Bibliography is given on colorimetry. Bausch & Lomb Optical Co., 637 St. Paul St., Rochester, N. Y.

INSTRUMENT INVESTMENT NEWS. The May issue contains the following articles: Prolonging the Life of the Vacuum Tube in Broadcasting; Bacterial Incubation Requires Stringent Temperature Control; The Speed of the Tenter Frame Controls Its Performance; Are Your Brakes Working Properly.

LABORATORY. Vol. Two, No. Three contains: Charles M. Hall and Aluminum; The Aluminum "Crown Jewels" and a number of instrument and apparatus descriptions. Fisher Scientific Company, 711 Forbes St., Pittsburgh, Pa.

MAGNIFIERS AND READERS. Price List illustrates and gives prices of various types. Bausch & Lomb Optical Co., 637 St. Paul St., Rochester, N. Y.

METERED COMBUSTION CONTROL. Feature No. 9 illustrates installation in a large industrial plant using pulverized fuel. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

MICARTA. Bulletin gives information on Micarta gears and pinions. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

OIL CIRCUIT BREAKERS. Bulletin No. 600 describes construction of oil circuit breakers. Roller-Smith Company, 233 Broadway, New York, N. Y.

PARKS' PARABLES. The June issue considers the importance of humidity control in various industries. Parks-Cramer Co., Fitchburg, Mass.

PYROMETERS. Bulletin No. 400, Supplement No. 1 discusses the application of this pyrometer and describes it. Roller-Smith Co., 233 Broadway, New York, N. Y.

QUARTZ MONOCHROMATOR. Leaflet gives information on B. & L. Quartz Monochromator. Bausch & Lomb Optical Company, 637 St. Paul St., Rochester, N. Y.

RECORDS THAT A MAN CAN SEE. Full size records made by various recorders are illustrated. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

ROUNDNESS GAUGE. Leaflet illustrates and describes Federal Model 36 Roundness gauge. Federal Products Corporation, Providence, R. I.

RESISTANCE THERMOMETERS. Catalog No. 93 gives complete information on Brown Resistance Thermometers. Brown Instrument Co., 4482 Wayne St., Philadelphia, Pa.

SCALES. Folder contains leaflets on several types of scales. Exact Weight Scale Co., Columbus, Ohio.

CHROMIUM-PLATING TEMPERATURE CONTROLLER. A leaflet briefly describes and illustrates the chromium-plating temperature controller. Form DMF-549. Foxboro Company, Foxboro, Mass.

DIAGONALLY - ROTATING AUTOCLAVE. Leaflet gives information on the "Edenborough" all steel diagonally-rotating autoclave. A. Gallenkamp & Co., Ltd., 19 Sun Street, Finsbury Square, London, E.C.2, England.

DRUM CONTROLLER. Leaflet 20388 describes a new line of reversing drum controllers for wound rotor induction motors. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

HOW HOT IS HOT? Direct mail piece briefly covers indicating, recording and controlling thermometer. Foxboro Company, Foxboro, Mass.

KELVIN BRIDGE. Note Book No. 4 discusses the purpose and theory of the Kelvin Bridge. Standard Kelvin bridges and accessories are illustrated and described. Other instruments covered are: Hoopes Conductivity Bridge; Students' Kelvin Bridge; Self-Contained Kelvin Bridge; Portable Kelvin Bridges; and Kelvin Bridge Temperature Recorder. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

MEGOHMER. Survey Number SI-58-QM reports on systematic tests with a 2-in-1 Megohmer made in the plant of a paper box manufacturer. Herman H. Sticht Co., 21 Park Row, New York, N. Y.

PHOTOMETERS. A revised edition of Catalog No. 60 covers the following instruments: the Bar Photometer; the Sphere Photometer; the Macbeth Illuminometer; the Taylor Reflectometer and L&N Potentiometers. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

PICKLING TANK TEMPERATURE CONTROL. Leaflet mentions advantages of pickling tank temperature control. Foxboro Co., Foxboro, Mass.

PORTABLE TACHOMETERS. Leaflet gives information on portable hand tachometers. Leaflet GC460A1. Foxboro Company, Foxboro, Mass.

RECORDING PSYCHROMETERS. Leaflet DMF 540 gives information on humidity recorder and controller. Foxboro Company, Foxboro, Mass.

SPEEDING UP PRODUCTION WITH AUTOMATIC CONTROL. Bulletin No. 110 covers the application of automatic control to machine tools. Monitor Controller Company, Baltimore, Md.

SYNCHRONOUS VISUAL SUPERVISORY CONTROL. Circular 1834 describes present types of supervisory control units, giving their application, advantages, and system of operation. Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

TEMPERATURE MEASUREMENT IN GENERATOR ROTATING FIELDS. This literature covers the purpose of the recorder, the principle and instruments used. Bulletin No. 871-A. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

NEW MODEL TOOL ROOM PRECISION LATHE. Catalog No. 90-A contains descriptions and prices of the entire line of lathes. Several new model lathes are added with this edition. South Bend Lathe Works, South Bend, Ind.

LIQUID METERS. Information and descriptions of positive displacement for measuring hot or cold water, oils, gasoline and all other liquids that are not chemically destructive, is given. Buffalo Meter Company, 2917 Main St., Buffalo, N. Y.

THERMOMETERS—RECORDING. Catalog No. 65 describes the Brown indicating and recording thermometers for measuring temperatures from —40° F. to +800° F. Brown Instrument Co., 4482 Wayne St., Philadelphia, Pa.

THIS IS THE MAN NOBODY CAN FOOL. Direct Mail Piece illustrates temperature control on bake oven and chromium plating tank. Bristol Company, Waterbury, Conn.

LIFE TEST APPARATUS FOR TRANSFORMER OILS. Bulletin No. 394 describes apparatus and method of making test. Eimer & Amend, Third Ave. and 18th St., New York, N. Y.

VOLTMETERS AND AMMETERS. Leaflet describes new small size recording voltmeters and ammeters. Full size chart is shown. Bristol Company, Waterbury, Conn.

WHO'S WHO IN GROUND TESTING. Bulletin 1245 lists companies using Ground Testers. Number of testimonials also given. James Biddle, 1211 Arch St., Philadelphia, Pa.

AMPLIFYING COMPARATOR. Leaflet describes and illustrates new amplifying comparator. B. C. Ames Co., Waltham, Mass.

BAROMETER & VACUUM RECORDER. Bulletin 150 describes a Combined Barometer and Vacuum Recorder. It gives a turbine operator "something to shoot at," in that it shows the absolute back pressure at a glance and enables him to maintain the highest vacuum possible for a given barometer reading. It also gives a picture of operation. Uehling Instrument Company, 473 Getty Ave., Paterson, N. J.

TYCOS-ROCHESTER. The July issue of this publication contains the following articles: Does Rain Come Through the Trees; When Two Men Together Climb Seven Miles; Making the Weather Produce More Business; Study of Climatic Influence; Storms Play Queer Tricks on Plant Life; The Physiological Effects of the Weather; Assuring Pure Air for City Dwellers. Taylor Instrument Companies, Rochester, N. Y.

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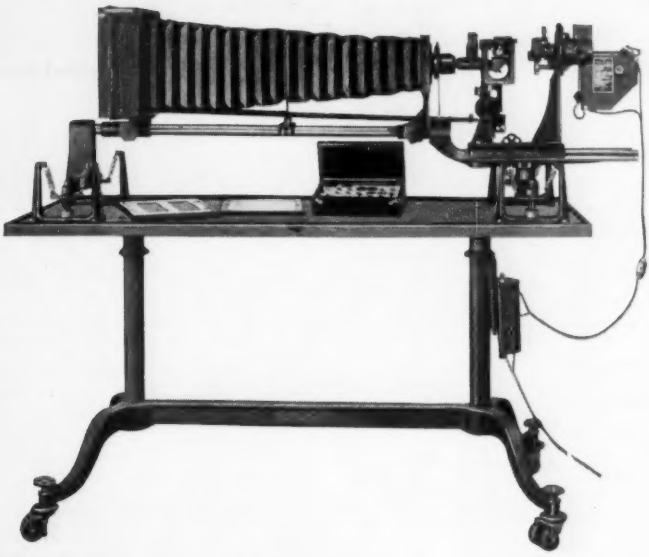

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CURRENT LITERATURE REVIEW

Abstracts on instruments and devices for measurement, inspection and control.

The Technology Department, Carnegie Library, Pittsburgh, Pa., will furnish photostats of material abstracted here. Negative prints are 35 cents per page, plus 10 cents for mailing (first class). All orders should be paid in advance. The library is not responsible for loss in mails.

A Receiver for Vacuum Distillation. Edgar J. Poth. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, p. 111.

Stopcocks are eliminated from the distillation train. An illustration is given of the pyrex glass device.—M.E.H.

Air Separator for the Laboratory. R. E. Zinn. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, p. 112.

By means of this device a qualitative separation effected by compressed air, can be obtained. It is useful for materials that do not screen easily because they are either too light or because the particles adhere to one anothr.—M.E.H.

Automatic Control in the Chemical Industries. Ismar Ginsberg. Ind. Engg. Chem., May 1929, pp. 410-414.

The role that the controlling, regulating and measuring instruments play in modern industry is discussed. Some particular types are considered.—M.E.H.

Mechanical Dispersion by Means of the Colloid Mill. Pierce M. Travis. Ind. Engg. Chem., May 1929, pp. 421-425.

The beater type, the smooth surface type and the rough surface type of colloid mill are discussed.—M.E.H.

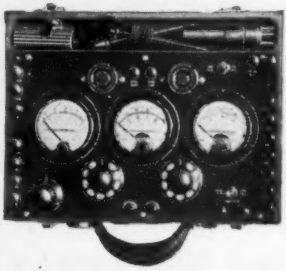
Works Control and Laboratory Equipment. Arthur Schroder. Ind. Engg. Chem., May 1929, pp. 481-485.

Here is given a survey of the developments in the technical control of products in the plant and in the laboratory by use of scientific instruments. Mention is made of some of the most modern pieces of control equipment.—M.E.H.

Laboratory Apparatus for the Study of Aging and Vulcanization of Rubber. R. Fric. Chim. et ind., April 1928, pp. 547-548.

An apparatus is described for heating a steel bomb in which accelerated aging tests may be made. The heating is effected by hysteresis currents induced by means of an alternating magnetic field. The alternating magnetic field is generated by a solenoid connected to a source of alternating current. The temperature is controlled by means of taps at different points in the solenoid winding and by resistance coils.—Abs. Bull. Kodak Res. Labs.

(Current Literature Review Continued on Page 18)



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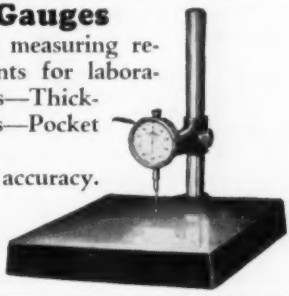

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Further Development in Photoelasticity. R. V. Baud. Jl. Opt. Soc., May 1929, pp. 422-437.

It has been customary in the past to machine the models used in photoelastic work either of glass or celluloid and to use a compensator for measuring the difference p—q between the principal stresses p and q, point by point.

In this paper a new method is outlined, consisting of using models, models made of a material of a large index of forced double refraction and of making photographs or drawings of the isochromatics of the loaded model and of a comparison strip in bending. By matching the colors of the model with those of the strip in bending, a complete quantitative record of the shear stress distribution throughout the model is obtained.

An example of the application of this new procedure is given for the case of a plate with a hole subjected to tension along one axis. Since the theory of elasticity offers an accurate solution for this particular case it can be used as a means of confirmation. The paper shows a very good agreement between analysis and experiment.

Experimental Methods of Studying Stress Distributions. R. V. Baud. Jl. Opt. Soc., May 1929, pp. 411-421.

The photoelastic, strain measurement, analogy and Lueder's line methods of studying stress distributions are discussed in this paper. It is concluded that these methods make extensive use of optics and it is suggested that this interesting field be given some attention by the optical industry.

A Direct Current Amplifier for Measuring Small Currents. J. M. Eglin. Jl. Opt. Soc., May 1929, pp. 393-402.

A direct-current amplifier consisting essentially of a Wheatstone bridge, having the amplifying tube in one arm and a balancing tube in another, has been described by P. I. Wold and C. E. Wynn-Williams. This circuit has now been developed to give a constant amplification for currents in either direction up to 10,000 times the lowest measurable value. The amplification and the lowest measurable current are alterable together by changing the resistance introduced between the grid and filament of the amplifying tube. With tubes of high insulation, the amplification can be made as large as 106; and the measurable current as low as 10-14 ampere. Some improvements of the circuit are: (1) the insertion of a resistance in series with the tube in one arm of the bridge to "compensate" for variations in plate and grid battery voltages; (2) the suspension of the tubes to protect them from mechanical vibrations; (3) the use of tubes with pure tungsten filaments to avoid changes in contact potentials, and with plates enclosing the filaments completely to lower the effects of wall charges. In a "null" method of using the circuit the values of the grid resistance and an auxiliary potential introduced in the grid-filament circuit are sufficient to determine the measured current.

Some Notes on the Drop-Weight Method for the Measurement of Surface Tension. A. Ferguson. Jl. Sci. Inst., May 1929, pp. 163-167.

The history and development of the method is briefly considered and Edwards apparatus described in the March issue of the Jl. Sci. Inst. is considered.

Instruments for the Measurement of Air Velocity. J. H. Parkin. Heating, Piping and Air Conditioning. June 1929, pp. 149-156.

A description is given of certain anemometers of the pressure type for measuring the velocity of air under low pressures. The construction, characteristics and limitations of the instruments are discussed and the precautions to be observed in their use are described.

A Modification of the Spectrophotometer for Obtaining Measurement on the Reflection of Light from Living Materials. L. A. Brunsting and C. Sheard. Jl. Opt. Soc., April 1929, pp. 349-353.

This paper describes a modified specimen holder for the Keuffel and Esser color analyser to be used for observations on the color of the human skin.

A Null Method for Measuring the Strength of a Magnetic Field. D. Inglis. Jl. Opt. Soc., April 1929, pp. 354-356.

Apparatus for a simple null method for measuring magnetic field strength is described.

Automatic Control for Industrial Heating Apparatus. G. C. Pearce. Fuels and Furnaces, May 1929, pp. 667-673.

This paper discusses some of the more common forms of automatic temperature control apparatus: thermostats, pyrometers, thermocouples, automatic control instruments, control panels and dual pyrometric control.

Temperature Control in the Brass Foundry. H. St. John. Fuels and Furnaces, May 1929, pp. 679-682.

Various types of pyrometers used for determining pouring temperatures are described.

Importance of Pyrometry in the Manufacture and Heat Treatment of Forgings. F. Goeckler. Fuels and Furnaces, May 1929, pp. 687-692.

The importance of careful pyrometric control of temperatures with instruments, constantly checked and inspected and operated by experienced operators is pointed out.

The Origin of the Echolots (Die Entstehung des Echolots). A. Behm, Zs. Feinmechanik, March 28, 1929, pp. 1-7.

The author describes an instrument developed by him for echo-sounding. This can also be used by aeroplanes to determine if they are over land or water, which would be of great importance in blind flying in fog.

(Current Literature Review Continued on Page 20)

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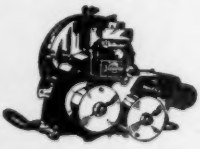

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Micrometer with Quick Adjustment (Mikrometer-Schraubenlehre mit Schnelleinstellung). Zs. Feinmechanik, April 13, 1929, pp. 9-10.

A new micrometer which can be quickly set is described.

Measuring the Speed of Light. The Sperryscope, Vol. 5, No. 11, pp. 1-3.

The equipment, built by the Sperry Company for Dr. Michelson to use in his experiments at Mount Wilson Observatory to measure the speed of light, is described briefly.

Damping Liquids for Instruments. G. H. Keulegan, N.A.C.A. Report No. 299.

The apparatus consisted of four capillary tube viscometers, which were immersed in a liquid bath in order to secure temperature control. The method of calibration and the related experimental data are presented in detail.

Operation Control Instrument and Recording Dynamometer (Betriebskontrollapparat und Registrierendes Dynamometer). Zs. Feinmech., April 30, 1929, pp. 1-4.

The instrument and its operation is described and illustrated.

New Water Meters (Neuzeitliche Wassermesser). Zs. Feinmech., May 15, 1929, pp. 1-7.

New meters described and some illustrated.

The Latest Developments in British Surveying Instruments. J. L. Atkinson. Jl. Chem. Met. & Mining Soc. of So. Africa, March 1929, pp. 195-212.

The author starts his historical development with the 17th Century and brings it up to date.

Testing of Concrete by Means of the Sklerometer (Betonpruefung mittels Sklerometer). H. Probst. Wirtschaftliche Technik, May 1929, pp. 76-78.

The testing of concrete products such as blocks, pipe, etc., by means of the Sklerometer (a scratch hardness tester) is urged. The method of making the test is given and two instruments available on the market at present are briefly described.

Altitude Flights. H. Henrickson. Aero Digest, May 1929, pp. 39-42.

This article gives information on the altitude flights made during 1928. Information on the instruments used in these flights is given.

The Magneto Compass. F. P. Wills. Aero Digest, May 1929, pp. 72-74.

The defects of the magnetic compass are given. The earth inductor compass is described and its advantages and disadvantages listed. The magneto compass is described.

The Distant Transmission of Measurements on Circuits of Any Type and Any Distance (Die Fernuebertragung von Messwerten auf Leitungen beliebiger Art und beliebiger Länge). M. Schleicher. Siemens Zs., April 1929, pp. 225-232.

The arrangement is described and illustrated.

Extending the Usefulness of the Oscillograph in Circuit Testing. I. H. Gerks. Bell Labs. Rec., May 1929, pp. 352-356.

A new amplifier for use with oscillographs is described. It may be changed from three stages to two stages by operating switches. The various applications of the amplifier are given as well as results obtained with and without its use.

Routine Tests in a Panel Office. L. Allen. Bell Labs. Rec., May 1929, pp. 365-368.

The various apparatus for locating faults are discussed.

Trouble Indicator. R. Marino. Bell Labs. Rec., May 1929, pp. 371-373.

The trouble indicator is described and illustrated.

A Slide Rule for Vector Calculations. M. Kruger. Bell Labs. Rec., June 1929, pp. 405-410.

A new slide rule is described. It reduces the work of compution very materially.

Determination of Molecular Weights in the Vapor Pressure and Evaporation Data. E. Washburn. B. of S. Jl. Res., April 1929, pp. 703-713.

If one determines at the same temperature the vapor pressure of a substance and the amount of it required to saturate, by aspiration, a measured volume of an indifferent gas, the molecular weight of the substance in the gaseous state is calculable. By employing a reference substance of known molecular weight the measurement of the volume of aspirated gas is unnecessary and the quantities measured have small temperature coefficients. A precision discussion of the method is given. It should be capable of a high degree in many cases and is applicable at much lower temperatures than are the methods commonly employed.

New, Manifold Reversing, Portable Transformers. (Neue, vielfach umschaltbare, tragbare Stromwandler.) A. Keller. Messtechnik, March 22, 1929, pp. 69-72.

The construction of two manifold reversing, portable transformers are described. Methods of use. Circuits. Accuracy with different ampere-turns and loads.

A New Method of Measuring the Thickness of Hard Cases. E. G. Herbert and P. Whitaker. Fuels and Furnaces, June 1929, pp. 923-926; Heat Treating and Forging, May 1929, pp. 575-578.

Paper before the British Iron & Steel Institute. This paper covers the development of a means for applying the differential method to the measurement of case thickness.

(Current Literature Review Continued on Page 22)

INSTRUMENTS BOOK SHELF

The books reviewed in this section can be supplied by Instruments Book Shelf, Instruments Publishing Company, Pittsburgh, Pa.

PRACTICAL STEEL MAKING. *Walter Lister.* Instruments Publishing Company, Pittsburgh, Pa., 1929. Cloth 6x9, 413 pages, 211 figs. Price $7.25 postpaid.

REVIEWED BY JOHN D. GAT

A reviewer cannot help himself from trying to find faults in a book which he is reading and usually he succeeds in his intention. At the beginning these defects stand out like a sore thumb until the book is finished, its meaning, purpose and interest are appreciated and balanced against defects in details. Practical Steel Making is remarkably free from them.

One may mildly wonder what calamity would happen if ganister which according to page 34 should have 95.32% SiO_2 is delivered to the plant having 95.34% or so silica. The indiscriminate use of metric and English units cannot be considered as a defect but rather as a sign of times when the merits of the former are making inroads in the strongholds of tradition.

The book is English both in terminology and subject matter. As long as the writer deals with questions having but one method of approach an American reader can greatly benefit from his description but the introduction of charging of limestone on the top of the charge, continuous doctoring of the slag, patching of the bottom while tapping would easily lead to almost a riot in an American plant.

Mr. Lister honestly tried to give to the reader the familiarity with steel making processes without the usual sweaty schooling on the floor. In this he succeeded admirably.

EXPERIMENTAL OPTICS. *Albert F. Wagner.* John Wiley & Sons, Inc., New York, 1929. Cloth 6x9½, 203 pages, 117 figs. Price $3.25 postpaid.

REVIEWED BY M. BERG RIMBACH

The author prepared this volume as a laboratory manual. It contains the fundamental practical work in optics given to junior officers of the United States Navy taking the Ordnance Course at the U. S. Navy Postgraduate School.

In the preface the author points out the importance for a fundamental knowledge of geometrical optics for the officers whose duty it will be to inspect the military telescopic instruments purchased by the Navy.

He deplores the almost negligible development of high-grade optical instruments by Americans as compared with Europeans. He states "The chief reasons for this seems to be lack of interest, and failure to appreciate the importance of the subject of geometrical optics.

The experiments cover: Index of Refraction and Spectrometry; Focal Lengths of Converging Lenses and Lens Systems; Focal Lengths of Diverging Lenses and Lens Systems; Lens Aberrations; Interference; Photometry; Polarized Light; Prisms; Spherometry; Telescopic Instruments; Testing of Optical Glass; Spherical Mirrors; Measurement of Constants of Microscopes; Miscellaneous Lens Tests; Invisible Spectrum Infra-Red and Ultra-Violet Spectrometry; Spectrophotometry; and Miscellaneous Supplementary Experiments.

A TREATISE ON CHEMICAL ENGINEERING APPLIED TO THE FLOW OF INDUSTRIAL GASES, STEAM, WATER, AND LIQUID CHEMICALS. *Geoffrey Martin.* Crosby Lockwood and Son, London, 1928. Cloth 6x9, 447 pages, 187 figs. 63 shillings.

REVIEWED BY RICHARD RIMBACH

This book provides the engineer with a means for calculating the flow of fluids of all kinds, and practical methods for estimating their speeds and volumes. The practical methods employed for estimating accurately the speeds of gases, liquids and vapors flowing in conduits of all descriptions, together with details of the calculations. Sixty-eight tables are given and permit rapid and immediate estimation of gaseous quantities.

As this is written for the practical engineer, the English system of units is used throughout. Also all explanations and subject matter are simple and clear, permitting the following of all mathetical derivations. The various symbols used are placed in close proximity to the corresponding formula. A number of practical examples are given, and the method of working them is shown.

A rather unique page numbering is used. The chapter is made the basis of page numeration, each chapter beginning with page 1 to the total number of pages in the chapter.

HANDBOOK OF THE PETROLEUM INDUSTRY. S. S. *Amdursky.* Taylor Instrument Cos., Rochester, N. Y., 1928. Cloth 8x11, 192 pages, 172 figs. Price $5.00 postpaid.

REVIEWED BY RICHARD RIMBACH.

The book is divided into three parts: Part 1 covers the production and refining of crude petroleum and the manufacture of natural-gas gasoline; Part 2 covers the more common laboratory tests applied to crude petroleum and its different refined components; Part 3 is a collection of tables relating to refinery practice.

The arrangement of the first two parts is unique in that processes and methods are covered in one column on the page and the instruments used are discussed in the column alongside.

Adequate Tests for Rubber Gloves. F. M. Farmer. Public Utility Purchasing, June 1929, pp. 139-144.

The testing of rubber gloves is considered.

Material Testing (Werkstoffprüfung). F. Meyer. Siemens Zs., March 1929, pp. 175-177.

A general discussion of physical testing.

The Development of Alternating Current Measuring Instruments for Telephone Work (Die Entwicklung der Wechselstrommessgeraete für die Fernsprechtechnik). W. Gebhardt. Siemens Zs., April 1929, pp. 222-225.

The advances made in the development of the instruments is reviewed and a number of instruments are illustrated.

Micromanometer Investigations (Mikromanometer-Untersuchungen). O. M. Faber. Messtechnik, May 22, 1929, pp. 123-126.

This article mentions the requirements placed by industry upon micromanometers. The new construction of Block, Rosenmueller, Askania and Neumann are discussed and compared. A new constructiog is proposed.

Orifice Steam Measurement with Apparatus Built in the Plant (Die Muendungsdampfmessung mit selbstgebauten Apparaten). E. Praetorius. Messtechnik, April 22, 1929, pp. 101-106; May 22, 1929, pp. 126-128.

The important applications and methods of measuring steam are briefly discussed. It is pointed out that, while for permanent installations the steam meters should be purchased, in individual cases apparatus built in the plant can be used. A prerequisite for satisfactory results are correct installation of recorders, and differential manometers. The most important practical rules and the theoretical basic principles are explained in separate sections.

Tabular Slide Rule for the Calculation of Operating Results for Measurements According to the Differential Pressure Principle. F. Wentzell. Messtechnik, April 22, 1929, pp. 93-101.

The Wentzell Tabular Slide Rule described in this paper permits carrying out in the simplest and quickest manner the calculations in the field of steam measurement, water measurement, compressed air measurement and gas measurement.

Spring Manometers and Thermometers (Federmanometer und Thermometer). Messtechnik, April 22, 1929, pp. 106-107.

Discussion of the article having the same title appearing in the December 22, 1928 issue of Messtechnik.

Synchronous Clocks (Synchronuhren "Electrochronos"). P. Schubert. A.E.G. Mitt., June 1929, pp. 412-414.

A new electric clock system is described, which no longer requires an individual line connection.

Synchronous Motors in Electric Meters (Synchronmotoren in Tarifapparaten). F. Ferrari. A.E.G. Mitt., June 1929, pp. 415-419.

This paper points out the advantages of the synchronous motor for meter clocks in comparison with the spring wound clock. The various applications are discussed.

Enameled Wire Testing Apparatus in the A.E.G. Cable Plant (Lackdraht-Pruefeinrichtungen im A.E.G.-Kabelwerk Oberspree). H. Hintze. A.E.G. Mitt., May 1929, pp. 364-368.

The apparatus is described and the electrical and physical properties of enameled wire discussed.

Recent Developments in Electricity Meters, with Particular Reference to those for Special Purposes. J. L. Carr. Instrument World, April 1929, pp. 357-360.

Abstracted from a paper read before the Institution of Electrical Engineers. This paper considers the recent developments and the details regarding meters which have been on circuit for some time.

Comparison of British and Foreign Ammeters and Voltmeters. Instrument World, April 1929, p. 367.

A brief extract of a report of an investigation made by the British Scientific Instrument Research Association.

Summary of Work Done During 1927-28 by the British Scientific Instrument Research Association. Instrument World, April 1929, pp. 368-369.

A brief extract from the Official Report of the Department of Scientific and Industrial Research.

Echo Sounding. R. Corringhame. Instrument World. April 1929, pp. 376-378.

Various instruments for this purpose are briefly discussed, and the Admiralty apparatus is illustrated.

A Note on the Haughton-Hanson Thermostat. A Method of Fine Adjustment. P. J. Durrant. Instrument World, May 1929, pp. 7-8.

Extract of a paper read before the Institute of Metals. A modification of the "cold-bulb" of the Haughton-Hanson thermostat is described, by means of which the temperature of the thermostat can be adjusted over a range of about 5° C. with an accuracy of 0.1° C.

(Current Literature Review Continued on Page 24)

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DRAFT GAUGES—see Gauges
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Electrocon Corporation
EARTH CURRENT METERS
Rawson Elec. Inst. Co.
ELECTRIC TELEMETER
Southwark Fdry. & Mach. Co.
EMPLOYEES' "IN AND OUT" TIME RECORDERS
ENGINE INDICATORS
American Instrument Co.
Lehmann & Michels
EXTENSOMETER (Huggenberger)
Southwark Fdry. & Mach. Co.
FAULT FINDERS
Leeds & Northrup Co.
Weston Electrical Inst. Corp.
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Tagliabue Mfg. Co., C. J.
Taylor Instrument Co.
FLOW METERS
Brown Instrument Co.
Builders Iron Foundry
Colonial Supply Co.
FLUXMETERS
Leeds & Northrup Co.
Rawson Electrical Instr. Co.
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Jewell Electrical Instrument Co.
Leeds & Northrup Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Inst. Corp.
Controlling
Leeds & Northrup Co.
Recording
Bristol Company
Leeds & Northrup Co.
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Burgess-Parr Co.
FUEL FLOW INDICATOR
Commercial Engg. Labs.
GALVANOMETERS
Brown Instrument Co.
Jewell Electrical Instrument Co.
Leeds & Northrup Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Inst. Corp.
GAS ANALYTICAL METERS
Chemical
Tagliabue Mfg. Co., C. J.
Electrical
Brown Instrument Co.
Leeds & Northrup Co.

The Analysis of Fluorspar. G. Lundell and J. Hoffman. B. of S. Jl. Res., April 1929, pp. 671-683.

In connection with the standardization of the Bureau of Standards standard sample of fluorspar No. 79, old methods of analysis were tested and modified, and new methods were developed. This paper sets forth the procedures that have been found desirable for the determination of carbonates, silica, calcium, fluoride, sulphur, barium, lead and zinc.

Calorimetric Investigations. (Kalorimetrische Untersuchungen.) A. Schuekarew. Messtechnik, March 22, 1929, pp. 63-65.

This article discusses the difficulty of determining the water equivalent of calorimetric bombs, compares the various methods. It develops a method which should be preferred for its simplicity and accuracy, and cites results.

Review of the Status and Problems of the Measurement of Dust. R. Meldan. Mestechnik, March 22, 1929, pp. 66-69.

The measurement of individual particles and accumulations suspended in gases are considered. The investigation of gas cleaners. The calibration of measuring devices. Approved measuring devices and types.

Apparatus for Thermomagnetic Analysis. R. L. Sanford. B. of S. Jl. Res., April 1929, pp. 659-670.

Thermomagnetic analysis consists in the study of magnetic effects occurring in a material during heating or cooling, with special reference to their interpretation in terms of structural changes or transformations. It is most conveniently carried out by means of a magnetometer of suitable type. The present paper describes thermomagnetic analysis apparatus set up at the Bureau of Standards and gives typical results obtained by its use.

Physical Properties of Ferrous Metals. Heat Treating and Forging, April 1929, pp. 442-445.

Part II, abstracted from January 1929 Research Group News. Meaning of the various characteristics of metals usually mentioned in specifications and methods of testing employed for their determination.

Manufacture of the U-Tube Manometer. Heat Treating and Forging. April 1929, pp. 487-488.

Article describes process of the Meriam Company.

Gas Testing. (Gaspruefung.) A. Sander. Zs. V. D. I., April 20, 1929, pp. 531-538.

Considerable stress is placed on uniform gas composition with the present day gas mixing operation of gas plants. The control of operation must solve important problems. As a consequence increased demands are made upon measuring instruments. The methods of gas testing which were much improved in recent years are thoroughly described.

New Constructions of Watermeters. (Neuere Bauarten Motorischer Wassermesser.) G. Eggers. Zs. V. D. I., April 20, 1929, pp. 557-563.

Operating pecularities of differential pressure meters and rotary meters are given. Various constructions are considered.

The Measurement of the Inductances and Effective Resistances of Iron-Cored Coils Carrying Both Direct and Alternating Current. L. Hartshorn. Jl. Sci. Insts., April 1929, pp. 113-115.

A method is described for the measurement of the effective inductance and resistance of coils of large self-inductance, which are required to carry a comparatively large direct current, with a superposed alternating current ripple. Hays' inductance bridge is used, with special arrangement for the independent control and measurement of the a.c. and d.c. components, the avoidance of earth-capacity effects without earth-connecting the d.c. supply, and the elimination of the direct current from the vibration galvanometer used as detector, without losing sensitivity. Typical results are given.

Integration of Flow Meter Diagrams. J. Hodgson. Jl. Sci. Insts., April 1929, pp. 116-118.

In the case of recording flow meters for which the movement of the pen is proportional to the "orifice head" or to some other differential pressure which is proportional to the square of the flow, it is often a matter of doubt as to whether too much error will be invalued by assuming that the mean flow is proportional t the square root of the mean head shown on the diagram; which mean head can be easily obtained by using an ordinary "area-measuring" or "radial planimeter." Actually the true flow is proportional to the mean f the square root of the mean head. In the present article this error is evaluated for various types of diagram for the first time, and a general rule is derived which enables one to see at a glance whether a diagram can be integrated directly by means of an ordinary planimeter, or whether it must first be replotted on a flow basis or integrated by means of a special square-rooting planimeter.

Differential Potentiometric Titration. III. An Improved Apparatus and Its Application to Precision Measurements. Duncan A. MacInnes and Malcolm Dole. Jl. Amer. Chem. Soc., Apr. 1929, pp. 1119-1127.

An improved apparatus for differential potentiometric titration, including a simple gas lift pump, is described. The usefulness of the method in analysis of high precision is shown in the titration of ferrous sulfate with dichromate and of potassium chloride with silver nitrate.—M.E.H.

A Method for Determining Vapor Densities at Room Temperatures. Erwin F. Linhorst. Jl. Amer. Chem. Soc., Apr. 1929, pp. 1165-1167.

The apparatus can easily be built from parts found in any chemical laboratory.—M.E.H.

Hygroscopicity of Fertilizer Materials and Mixtures. J. Richard Adams and Albert R. Merz. Ind. Engg. Chem., Apr. 1929, pp. 305-307.

A diagram and description of apparatus are given.—M.E.H.

Modified du Noüy Tensimeter Studies in the Drying Oils. D. S. Chamberlin, E. R. Theis, P. F. Schlingman and J. S. Long. Ind. Engg. Chem., Apr. 1929, pp. 333-338.

A modified du Noüy tensimeter for use with oils and varnishes is described. Minimum figures for the critical temperature of some drying oils were determined by direct observation.—M.E.H.

The Hydration of Animal Skin by the Volume Change Method. E. R. Theis and Harvey A. Neville. Ind. Engg. Chem., Apr. 1929, pp. 377-379.

The swelling of animal tissues has been studied by the change-in-volume method. The apparatus is essentially a simple dilatometer and measures accurately the slightest change in volume. —M.E.H.

Apparatus and Methods for the Separation, Identification and Determination of the Chemical Constituents of Petroleum. E. W. Washburn, J. H. Bruun and M. M. Hicks. Research Paper 45, Bur. of Standards, 21 pages.

A Technical Method of Using the Mercury Arc to Obtain Data at Wave Length 560 mu in the Spectrophotometric Analysis of Sugar Products. H. H. Peters and F. P. Phelps. Research Paper 38, Bur. of Standards, 8 pages.

Methods of Determining the H-Ion Concentration of Soils. E. F. Snyder. Dept. of Agriculture, Circular 56, 30 pages.

Tests of a New Type of Glass Electrode. Duncan A. MacInnes and Malcolm Dole. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, pp. 57-59.

Glass electrodes described here were found to respond only to changes of H-ion concentration, being independent of oxidation-reduction potentials existing in the solutions.—M.E.H.

Problems in the Estimation of Unsaturated Hydrocarbons in Gases. I-Separation by Fractional Distillation. Harold S. Davis. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, pp. 61-64.

This paper describes a column composed of a narrow glass spiral surrounded by a silvered vacuum jacket in which liquified gases can be fractionated almost as easily as ordinary liquids. —M.E.H.

A Self-Regulating Gas-Flowmeter. Lyman Chalkley, Jr. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, pp. 74-75.

A simple gas-flow regulator is described and diagram given.—M.E.H.

A New Automatic Pipet. L. N. Markwood. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, p. 82.

The pipet consists of a bulb with overflow, and a liquid-tight valve rod.—M.E.H.

Coated Spiral Fractionating Columns. Thomas Midgley, Jr. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, pp. 86-88.

Some very efficient fractionating columns and curves showing their functioning are described. —M.E.H.

Chart of Indicators for pH Measurements. Clarke E. Davis and Henry M. Salisbury. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, p. 92.

The chart has been found useful in quickly judging the pH of solutions and of spot tests on dry materials.—M.E.H.

The Fiber-Saturation Point of Wood as Obtained from Electrical Conductivity Measurements. Alfred J. Stamm. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, pp. 94-97.

A method for determining the fiber-saturation point of wood by electrical conductivity has been developed so as to minimize the effect of moisture gradients.—M.E.H.

A Heavy-Duty Thermostat. D. F. Othmer. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, p. 97.

A simple rugged thermostat to control at least 4000 watts and maintain the temperature of a small boiler constant to 0.02 degree C. for days at a time, is described.—M.E.H.

Standardization of Conditions for Measuring the Detonation Characteristics of Motor Fuels. R. Stanfield and F. B. Thole. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, pp. 98-105.

Three designs of engine are described with entirely different combustion-chamber shapes and valve arrangements. Tests show that substantially qual results for antiknock value can be obtained from any of the engines if comparisons are made in terms of equivalent blends of standard spirits and provided that test conditions are suitably controlled.—M.E.H.

A Temperature-Recording Micropress for Studying the Course of Vulcanization. James C. Walton. Ind. Engg. Chem., Analyt. Ed., Apr. 1929, pp. 106-108.

This electrically heated micropress permits the duplication of press cures on a small scale and renders it possible to determine the temperature at which various changes take place during the cure.—M.E.H.

(Current Literature Review Continued on Page 27)

GAS LEAK INDICATORS
Colonial Supply Co.
Taylor Instrument Companies
GAS-METERS
Brown Instrument Co.
GAUGE RODS
Tagliabue Mfg. Co., C. J.
GAUGES
Absolute Pressure
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Colonial Supply Co.
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A Continuous Still for Conductivity Water. C. C. DeWitt and Geo. Granger Brown. Ind. Engg. Chem., Analyt. Ed., Apr. 15, 1929, pp. 109-111.

A Double-Reflexion Level. D. S. Perfect. Trans. Opt. Soc., 1928-1929, Vol. XXX, No. 3, pp. 126-129.

The level described in this paper was designed to assist the initial leveling of a floating system and to enable observations to be made on the constancy of level over extended periods of time. Its error may be determined by direct measurement and without reversal. The level in any direction is shown. The device has proved quite convenient in use and may possibly be found suitable for other purposes.

A New Determination of the Melting Point of Palladium. C. O. Fairchild, W. H. Hoover and M. F. Peters. Jl. of Res., May 1929, pp. 931-962.

The melting point of palladium was determined by measuring with an optical pyrometer the ratio of brightness of the red light ($\lambda = 0.6528$) emitted by black bodies at the melting points of palladium and gold, respectively. The crucible method was shown to be more reliable than the wire method. Especial attention was given to the purity of the metals. The result obtained by the crucible method, when substituted in Wien's or Planck's equation, gives the melting point of palladium as 1,556.6° C. with an uncertainty of 1°.

Note on Skew Pencils Traversing a Symmetrical Instrument. T. Smith. Trans. Opt. Soc., 1928-1929, Vol. XXX, No. 3, pp. 130-133.

Image points on a chief ray in a primary plane of a symmetrical instrument for which the light path is constant for a light fan lie between the primary and secondary foci. When the chief ray is skew this is no longer generally true. The absence of astigmatism in a pencil of which the chief ray is skew involves three conditions.

On Color Measurement. (Ueber Farbenmessung.) F. A. O. Krüger. Zeits. V. D. I., Apr. 6, 1929, pp. 465-468.

This article discusses the Ostwald method of color measurement with the Pulfrich step photometer in conjunction with the Krüger accessory apparatus.

A Vacuum Arc Lamp of New Design for Spectroscopic Work. K. Prosad. Jl. Sci. Insts., April 1929, pp. 126-130.

This new arc lamp differs mainly from the types hitherto employed in that, by a suitable electromagnetic device, the arc can be struck in vacuum from outside as often as desired and can be run without attention for about an hour or so at a stretch, while the vacuum seal is so simply made that, even if the arc is to be uncovered, the time taken in re-sealing the cover air-tight is very short.

A New Self-Adjusting Pipette. E. G. Bilham. Jl. Sci. Insts., April 1929, pp. 119-120.

By means of an inner tube forming an extension of the ordinary discharge jet of a pipette, a fixed quantity of liquid is retained and can be recovered by pouring out from the top of the pipette. Pipettes of this pattern have been found useful for purposes where definite fixed quantities of water or other liquid have to be measured rapidly and accurately.

Contacts in Apparatus for Measuring Electrical Resistivity. J. L. Haughton. Jl. Sci. Insts., April 1929, pp. 120-124.

In the measurement of electrical resistances by means of potential drop methods four contacts are required. Methods for making these contacts with the resistance to be measured, both in the cold and at high temperatures, are discussed, and types of contacts suitable for different requirements are specified.

A Simple Earthing Switch for Small Electrometers. E. B. Moss. Jl. Sci. Insts., April 1929, pp. 124-126.

A small earthing switch is described which is particularly suitable for use on a Lindemann Electrometer. It is suitably shielded and adds little to the capacity of the instrument.

Theoretical Foundation of Flicker Photometry. P. Lasareff. Zs. Physik, Nov. 16, 1928, pp. 119-125.

Flicker and equality of brightness are discussed on the basis of a photochemical theory of vision. —Abs. Bull. Kodak Res. Labs.

An Interference Method for the Determination of Axial and Oblique Aberrations. A. Bennett. B. of S. Jl. Res., April 1929, pp. 685-702.

An interference method for the determination of the axial and oblique monochromatic aberrations of a lens system is described. Equations necessary in the design of the apparatus, and for the computation of the results are given. The simplicity of the apparatus, especially the use of but one auxiliary reflecting surface lessens the probability of large instrumental errors. The aberrations of three astronomical objectives are investigated, and the results are expressed in the form of phase contours.

Electric Individual Clocks with Pendulum Drive. (Elektrische Einzeluhren mit Pendelantrieb.) P. Gittinger. Zs. Feinmechanik., Jan. 18, 1929, pp. 1-5.

A clock in which the hand winding is replaced by electric winding is described.

A Small Bussolen Tachymeter. (Ein Kleines Bussolentachymeter.) K. Ludemann. Allgem. Ver Nach., April 3, 1929, pp. 212-221.

The advantages of the instrument are listed.

A Semi-Micro Zeisel Methoxyl Method. E. P. Clark. Jl. Amer. Chem. Soc., May 1929, pp. 1479-1483.

A description is given of an apparatus and a procedure for the determination of methoxyl groups in samples of the order of 20 mg.—M.E.H.

(Current Literature Review Continued on Page 29)

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Hardness Tests in Production. (Harteprüfungen in der Fliessarbeit.) Zeits. V. D. I., Apr. 6, 1929, pp. 471.

Describes a hardness testing machine which can use either a ball or diamond point.

The Control of Current Density in Plating Baths. W. Pfanhauser. Korrosion und Metallschutz, Apr. 1929, pp. 72.

This article describes an instrument for measuring the current density of plating baths.

Surface Heat Transmission. R. H. Heilman. Mech. Engg., May 1929, pp. 355-359.

This paper gives particulars regarding the methods employed in determining surface coefficients; the radiometer used; the determination of emissivity coefficients; derivation of an equation for convection.

An Analysis of the Arc and Spark Spectra of Yttrium. W. Meggers and H. Russel. B. of S. Jl. Res., April 1929, pp. 733-770.

All the available data (wave-length measurements and intensity estimates, temperature classes, Zeeman effects) on yttrium lines have been correlated and interpretated in an analysis of the arc and spark spectra. The total number of lines classified is 448 in the Yt I spectrum, 223 in the Yt II spectrum, and 10 in the Yt III spectrum.

Investigations of Molybdenum Steels to Test the Possibility of Using Them as Permanent Magnets. (Untersuchungen an Molybdaenstachlen zur Pruefung ihrer Verwendbarkeit als Dauermagnete.) A. Slogoff and W. Messkin. Archiv fuer Eisenhuettenwesen, March 1929, pp. 595-600.

Determination of the magnetic properties of steels with 0.16 to 4.48% Mo and 0.65 to 1.5% C. in relation to the hardening temperature in hardening in oil and water. Influence of holding time at hardening temperature. Aging. Comparison with chrome and tungsten magnet steels.

Calibration of Sixty-five 35-Yellow Lovibond Glasses. I. Priest, D. Judd, K. Gibson and G. Walker. B. of S. Jl. Res., April 1929, pp. 793-819.

This report deals with 65 nominally 35-yellow Lovibond glasses collected from members of the American Oil Chemists' Society, submitted to the Bureau of Standards in August, 1927, by H. P. Trevithick, and identified by AOCS numbers engraved on the glasses. It is understood that Mr. Trevithick has a key to these numbers showing the ownership of each glass.

Note on an Electrical Conductance Method for Determining Liquefaction Temperatures of Solids. E. Washburn and E. Smith. B. of S. Jl. Res., April 1929, pp. 787-791.

A conductance method for measuring liquefaction temperatures, which requires only a few milligrams of the substance investigated, is described. The method has been applied to the determination of eutectic temperatures of water-salt systems and to the determination of transition temperatures of salt hydrates. The method is applicable to any system which is practically a nonconductor of electricity below the liquefaction temperature and which abruptly exhibits an appreciable conductance at this temperature.

The Precise Measurement of X-Ray Dosage. L. Taylor. B. of S. Jl. Res., April 1929, pp. 771-785.

A comparison of the unit of X-ray dosage was made by Behnken and showed a variation of 4 per cent between various laboratories. For the purpose of definition and constancy a well controlled direct-current voltage source is provided for the X-ray tube. Using this, a comparison was made between the various methods using the same equipment for all. A large parallel plate ionization chamber was used to measure the r unit as defined by international agreement. The discrepancies were found to be due to the electrostatic field distortion introduced by the various ionization current measuring devices. For the purpose of measuring r precisely a null method is used and described. Sources of error are discussed and their probable magnitude indicated in certain cases. Under known conditions the difference between Behnken's and Glaser's determination has been duplicated in order of magnitude and in direction. A complete description of the Bureau of Standards equipment for the standard measurement of Rontgen dosage is given.

The Compressive and Transverse Strength of Brick. J. McBurney. B. of S. Jl. Res., April 1929, pp. 821-835.

This paper reports the compressive strength flat and on edge and the transverse strength of 27 makes of bricks covering a range of conditions in method of manufacture and degree of burning. The attempt is made to correlate the variation in ratios of these different measures of strength with the various structural features of the brick.

Microscopic Composition and Structure of Prepared Thomas Slags and Relation to Solubility in Citric Acid. (Mikroskopische Zusammensetzung und Gefuege verschieden vorbehandelter Thomasschlacken und ihre Beziehungen zur Zitronensaeureloeslichkeit.) H. Schneiderhoehn. Stahl und Eisen, March 14, 1929, pp. 345-353.

This article gives results on microscopic investigations of slags.

Knotch Toughness and Statistical Index Numbers. (Kerbzaehigkeit und Statische Kennziffern.) W. Kuntze. Archiv fuer Eisenhuettenwesen, March 1929, pp. 583-593.

Influence of the deformation speed on the curve of true stress. Relations between notch toughness and the tensile strength as well as the deformation properties of the materials of the same chemical composition. Type of test piece. Tests with various materials. Abstract in Stahl und Eisen, March 21, 1929, pp. 394.

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THE INSTRUMENT EXHIBITS AT THE IRON & STEEL EXPOSITION, PITTSBURGH, PA.

INSTRUMENTS, Vol. 2, No. 7, July, 1929, pp. 225-226, 1 fig.

A complete report of the instrument exhibits.

THE RADIAL PLANIMETER.

JOHN L. HODGSON, INSTRUMENTS, Vol. 2, No. 7, July 1929, pp. 227-232, 6 figs.

The theory of the radial planimeter is considered and a method presented which enables this planimeter to be used for averaging "orifice head" charts in which the spacing is slightly distorted from exact proportionality to the "head" by the presence of cranks or similar mechanisms in the flow-meter.

A SLIDE RULE FOR FILTER COMPUTATIONS.

M. K. KRUGER, INSTRUMENTS, Vol. 2, No. 7, July 1929, pp. 233-238, 5 figs.

A slide rule for filter computations is described and its use illustrated by means of problems. With slight modifications this rule would be advantageous for general engineering and student use.

THE DETERMINATION OF COKE YIELDS FOR THE COKE PLANT BASED ON A DISTILLATION TEST.

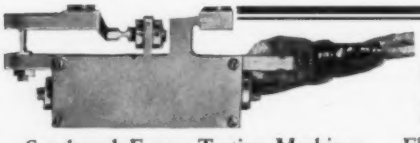
DR. L. LITINSKY, INSTRUMENTS, Vol. 2, No. 7, July 1929, pp. 239-242, 2 figs.

The method is described and the calculations required are illustrated by means of an example.

COMPRESSION INSTRUMENT FOR MEASURING THE STRENGTHS OF FOUNDRY SANDS.

H. L. CAMPBELL, INSTRUMENTS, Vol. 2, No. 7, July 1929, pp. 243-244, 2 figs.

An instrument for the determination of compressive strengths of molding sands is given.



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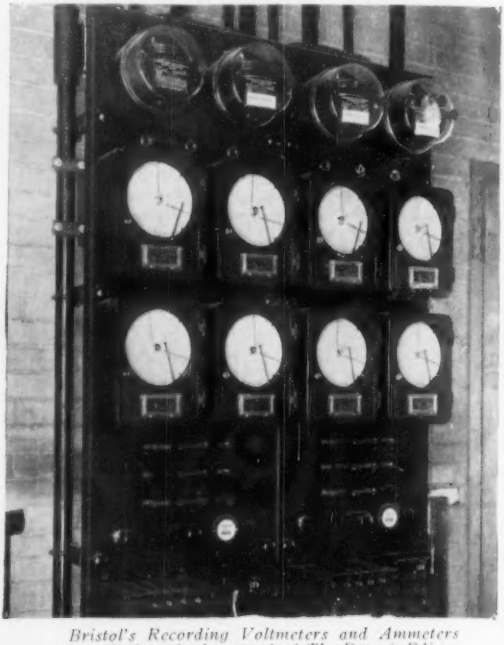

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